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(54) **Quinoline type mevalonolactones.**

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Description

The present invention relates to novel mevalonolactones having a quinoline ring, process s for their production, pharmaceutical compositions containing them and their pharmac utical uses particularly as anti-hyperlipidemic, hypolipoproteinemic and anti-atherosclerotic agents, and intermediates useful for their production and processes for the production of such intermediates.

Some fermentation metabolic products such as compactine, CS-514, Mevinolin or semi-synthetic derivatives or fully synthetic derivatives thereof are known to be inhibitors against HMG-CoA reductase which is a rate limiting enzyme for cholesterol biosynthesis. (A. Endo J. Med Chem., 28(4) 401 (1985))

CS-514 and Mevinolin have been clinically proved to be potentially useful anti-hyperlipoproteinemic agents, and they are considered to be effective for curing or preventing diseases of coronary artery sclerosis or atherosclerosis. (IXth Int. Symp. Drugs Affect. Lipid Metab., 1986, p30, p31, p66)

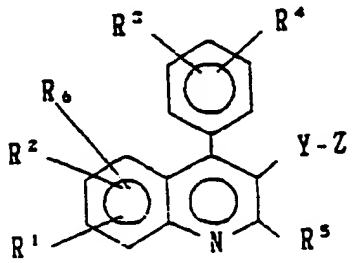
However, with respect to fully synthetic derivatives, particularly hetero aromatic derivatives of inhibitors against HMG-CoA reductase, limited information is disclosed in the following literatures:

WPI ACC NO. 84-158675, 86-028274, 86-098816, 86-332070, 87-124519, 87-220987, 88-07781, 88-008460, 88-091798 and 88-112505.

US-A-4,761,419 discloses, that certain trans-6-[[(substituted)quinolinyl]ethyl]-and ethenyl]tetrahydro-4-hydroxypyran-2-ones and the corresponding dihydroxy ring-opened acids derived therefrom are potent inhibitors of the enzyme 3-hydroxy-3-methylglutaryl-coenzyme A reductase (HMG-CoA reductase) and are useful as hypocholesterolemic and hypolipidemic agents.

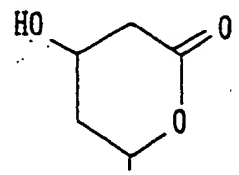
The present inventors have found that mevalonolactone derivatives having a quinoline ring, the corresponding dihydroxy carboxylic acids and salts and esters thereof have high inhibitory activities against cholesterol biosynthesis wherein HMG-CoA reductase acts as a rate limiting enzyme. The present invention has been accomplished on the basis of this discovery.

The novel mevalonolactone derivatives of the present invention are represented by the following formula I:



(I)

wherein R^1 is hydrogen, C_{1-4} alkyl, C_{1-3} alkoxy, n-butoxy, i-butoxy, sec-butoxy, R^7R^8N-(wherein R^7 and R^8 are C_{1-3} alkyl), fluoro, chloro, bromo or benzyloxy;
R^2 is hydrogen, C_{1-4} alkyl, C_{1-3} alkoxy, n-butoxy; i-butoxy, sec-butoxy, fluoro, chloro or bromo;
or when located at the ortho position to each other, R^1 and R^2 together form -CH=CH-CH=CH-;
R^3 is hydrogen, C_{1-4} alkyl, C_{1-3} alkoxy, n-butoxy, i-butoxy, sec-butoxy, fluoro, chloro, bromo, trifluoromethyl, phenoxy, phenyl or benzyloxy;
R^4 is hydrogen, C_{1-4} alkyl, fluoro, chloro or bromo;
R^5 is C_{1-6} alkyl, C_{3-6} cycloalkyl or phenyl;
R^6 is hydrogen;
Y is $-CH_2-$, CH_2CH_2-, -CH=CH-, $-CH_2-CH=CH-$ or $-\overset{\backslash}{C}H=CH-CH_2$; and Z is



or -Q-CH_2-W-CH_2-CO_2R^{12}
(wherein Q is -C(O)- or -CH(OH)-; W is -C(O)- or -CH(OH)-; and R^{12} is hydrogen, physiologically hydrolyzable alkyl, NH_4, sodium, potassium or 1/2 calcium).

Various substituents in the formula I will be described in detail with r f rence to specific examples. However, it should be understood that the present invention is by no means restricted by such specific examples.

C_{1-4} alkyl for R^1, R^2, R^3 and R^4 includes, for example, methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, sec-butyl and t-butyl. C_{1-3} alkoxy for R^1, R^2 and R^3 includes, for example, methoxy, ethoxy, n-propoxy and i-propoxy.

C_{1-6} alkyl for R^5 includes, for example, methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, sec-butyl, t-butyl, n-pentyl and n-hexyl.

C_{3-6} cycloalkyl for R^5 includes, for example, cyclopropyl, cyclobutyl, cyclopentyl and cyclohexyl.

C_{1-3} alkyl for R^7 and R^8 includes, for example, methyl, ethyl, n-propyl and i-propyl.

Further, these compounds may have at least one or two asymmetric carbon atoms and may have at least two to four optical isomers. The compounds of the formula I include all of these optical isomers and all of the mixtures thereof.

Among compounds having carboxylic acid moieties falling outside the definition of $-CO_2R^{12}$ of the carboxylic acid moiety of substituent Z of the compounds of the present invention, those which undergo physiological hydrolysis, after intake, to produce the corresponding carboxylic acids (compounds wherein the $-CO_2R^{12}$ moiety is $-CO_2H$) are equivalent to the compounds of the present invention.

Now, preferred substituents of the compounds of the present invention will be described.

In the following preferred, more preferred still further perferred and most preferred examples, the numerals for the positions of the substituents indicate the positions on the quinoline ring. For example, N' shown by e.g. 1' or 2' indicates the position of the substituent on the phenyl substituted at the 4-position of the quinoline ring (the carbon connected to the quinoline ring is designated as 1'). The meanings of the respective substituents are the same as the above-mentioned meanings.

Preferred substituents for R^1 is hydrogen, fluoro, chloro, bromo, C_{1-3} alkyl, C_{1-3} alkoxy, dimethylamino, and benzyloxy, and R^2 is hydrogen, fluoro, chloro, bromo, C_{1-3} alkyl,C_{1-3} alkoxy.

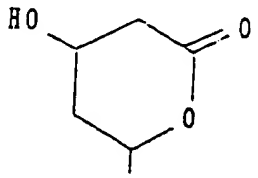
As preferred examples for R^3 and R^4, when R^4 is hydrogen, R^3 is hydrogen, 3'-fluoro, 3'-chloro, 3'-methyl, 4'-methyl, 4'-chloro and 4'-fluoro.

Other preferred combinations of R^3 and R^4 include 3'-methyl-4'-chloro, 3',5'-dichloro, 3',5'-difluoro, 3',5'-dimethyl and 3'-methyl-4'-fluoro.

Preferred examples for R^5 include primary and secondary C_{1-6} alkyl and C_{3-6} cycloalkyl.

Preferred examples for Y include $-CH_2-CH_2-$ and -CH=CH-.

Preferred examples for Z include



-CH(OH)CH_2CH_2(OH)$CH_2CO_2R^{12}$ and -CH(OH)CH_2C(O)$CH_2CO_2R^{12}$.

Now, more preferred substituents of the compounds of the present invention will be described.

As more preferred examples for R^1 and R^2, when R^2 is hydrogen, R^1 is hydrogen, 5-fluoro, 6-fluoro, 7-fluoro, 8-fluoro, 5-chloro, 6-chloro, 7-chloro, 8-chloro, 5-bromo, 6-bromo, 7-bromo, 8-bromo, 5-methyl, 6-methyl, 7-methyl, 8-methyl, 5-methoxy, 6-methoxy, 7-methoxy, 8-methoxy, 6-ethyl, 6-n-butyl and 7-dimethylamino;

or R^1 and R^2 together represent 6-chloro-8-methyl, 6-bromo-7-methoxy, 6-methyl-7-chloro, 6-methoxy-7-chloro, 6-chloro-7-methoxy, 6-chloro-8-bromo, 6-bromo-8-chloro, 5-methyl-8-chloro, 6-methoxy-7-methyl, 6-chloro-8-bromo, 6-methyl-8-bromo, 6,7-difluoro, 6,8-difluoro, 6,8-dichloro, 5,8-dimethyl, 6,8-dimethyl, 6,7-dimethoxy, 6,7-diethoxy, 6,7-dibromo or 6,8-dibromo.

As more preferred examples for R^3 and R^4, when R^3 is hydrogen, R^4 is hydrogen, 4'-methyl, 4'-chloro or 4'-fluoro. When both R^3 and R^4 are not hydrogen, they together represent 3',5'-dimethyl or 3'-methyl-4'-fluoro.

As more preferred examples for R^5, the above-mentioned preferred examples of R^5 may be mentioned.

As pr ferred examples for Y, $-CH_2-CH_2-$ and (E)--CH = CH- may be mentioned. As more preferred examples for Z, the above preferred xamples for Z may be mentioned.

Now, still further preferred substituents of the compounds of the present invention will be described. As xamples for R^1 and R^2, when R^2 is hydrogen, R^1 is hydrogen, 6-m thyl, 6- thyl, 6-trifluoromethyl, 6-hydroxy, 6-methoxy, 6-chloro, 6-bromo, 6-n-butyl and 7-dimethylamino; or

R^1 and R^2 represent 6,8-dichloro, 5,8-dimethyl, 6,8-dimethyl, 6,7-dimethoxy, 6,7-diethoxy, 6,7-dibromo, 6,8-dibromo, 6,7-difluoro and 6,8-difluoro.

As still further preferred examples for R^3 and R^4, when R^3 is hydrogen, R^4 is hydrogen, 4'-chloro or 4'-fluoro, or R^3 and R^4 together represent 3'-methyl-4'-fluoro.

Still further preferred examples for R^5 include ethyl, n-propyl, i-propyl and cyclopropyl.

Still further preferred examples for Y include (E)--CH = CH-.

As still further preferred examples for Z, the above-mentioned preferred example for Z may be mentioned.

Now, the most preferred substituents for the compounds of the present invention will be described.

As the most preferred examples for R^1 and R^2, when R^2 is hydrogen, R^1 is hydrogen, 6-methyl or 6-chloro; or

R^1 and R^2 together represent, for example, 6,7-dimethoxy.

As the most preferred examples for R^3 and R^4, when R^3 is hydrogen, R^4 is hydrogen, 4'-chloro or 4'-fluoro.

The most preferred examples for R^5 include i-propyl and cyclopropyl. The most preferred example for Y may be (E)--CH = CH-.

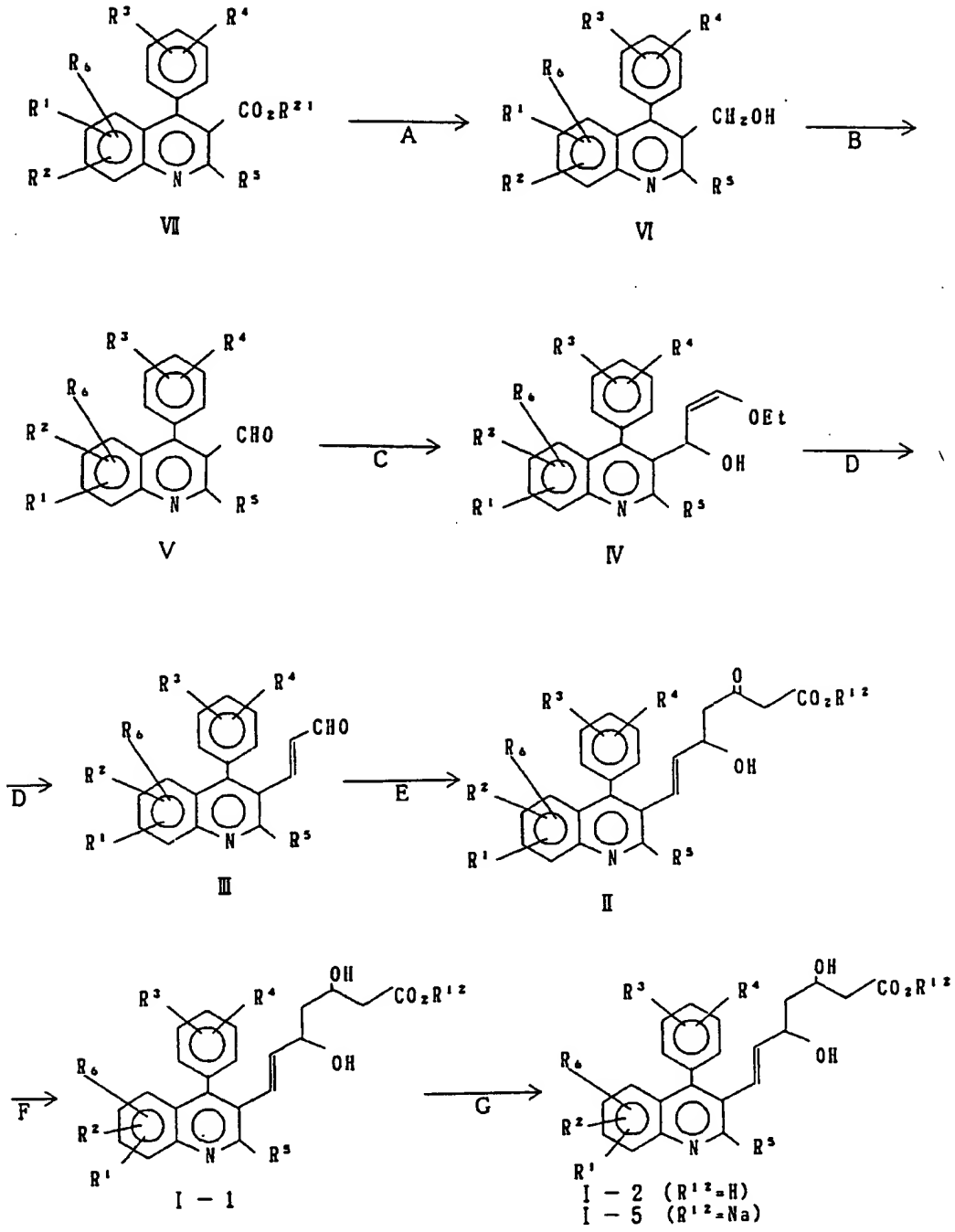
As the most preferred examples for Z, the above-mentioned preferred examples for Z may be mentioned.

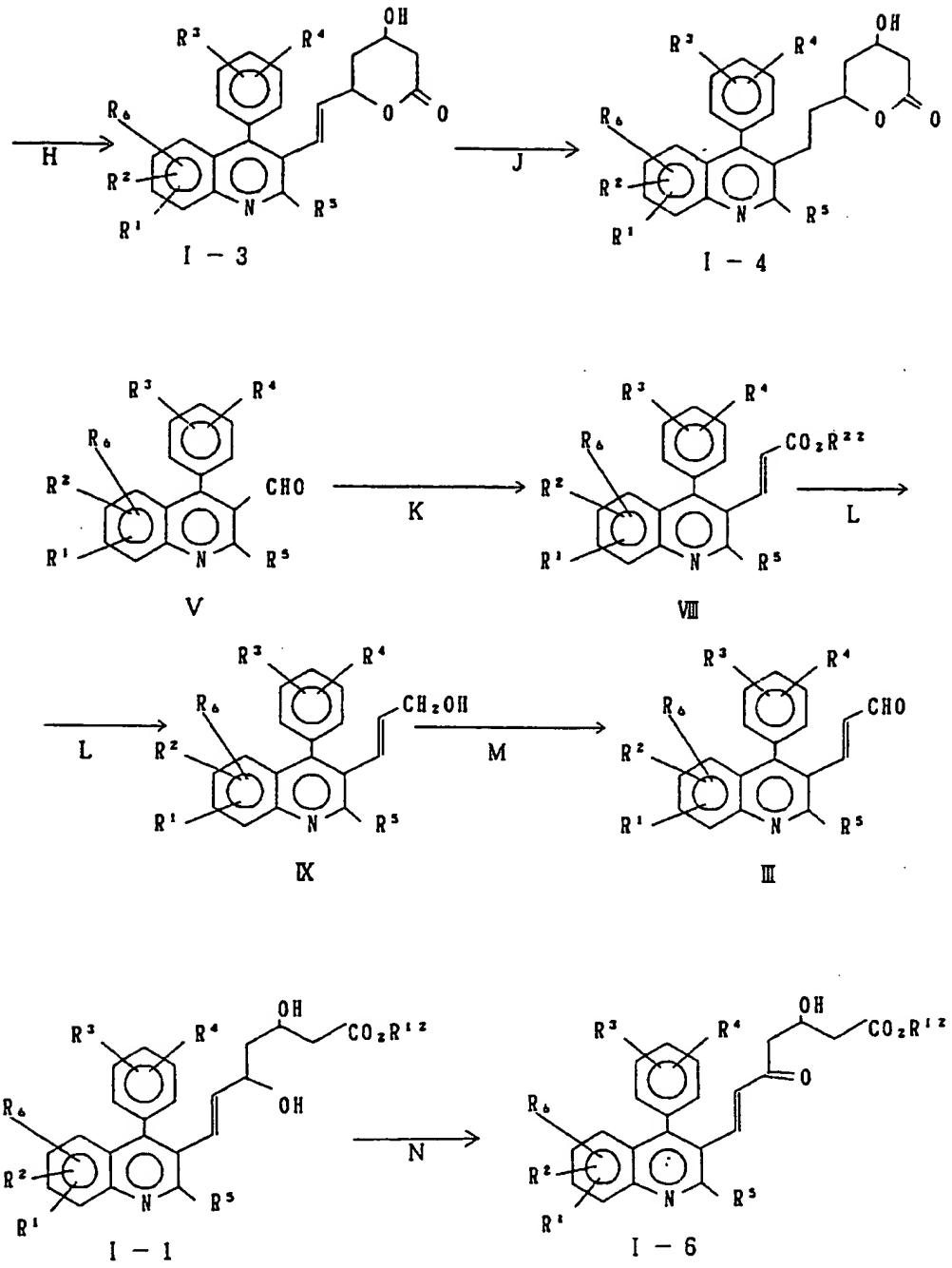
Now, particularly preferred specific compounds of the present invention will be presented. The following compounds (a) to (z) are shown in the form of carboxylic acids. However, the present invention include not only the compounds in the form of carboxylic acids but also the corresponding lactones formed by the condensation of the carboxylic acids with hydroxy at the 5-position, and sodium salts and lower alkyl esters (such as methyl, ethyl, i-propyl and n-propyl esters) of the carboxylic acids, which can be physiologically hydrolyzed to the carboxylic acids.

(a) (E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-quinolin-3'-yl]-hept-6-enoic acid
(b) (E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid
(c) (E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid
(d) (E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid
(e) (E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-cyclopropyl-quinolin-3'-yl]-hept-6-enoic acid
(f) (E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-cyclopropyl-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid
(g) (E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-cyclopropyl-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid
(h) (E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-cyclopropyl-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid
(i) (E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-(1"-methylethyl)-quinolin-3'-yl]-hept-6-enoic acid
(j) (E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-(1"-methylethyl)-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid
(k) (E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-(1"-methylethyl)-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid
(l) (E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-(1"-methylethyl)-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid
(m) (E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-cyclopropyl-quinolin-3'-yl]-hept-6-enoic acid
(n) (E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-cyclopropyl-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid
(o) (E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-cyclopropyl-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid
(p) (E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-cyclopropyl-6'7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid
(q) (E)-3,5-dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-quinolin-3'-yl]-hept-6-enoic acid
(r) (E)-3,5-dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid
(s) (E)-3,5-dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid
(t) (E)-3,5-dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid
(u) (E)-3,5-dihydroxy-7-[4'-phenyl-2'-cyclopropyl-quinolin-3'-yl]-hept-6-enoic acid
(v) (E)-3,5-dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid
(w) (E)-3,5-dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid
(x) (E)-3,5-dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid
(y) (E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl-2'-(1"-methylethyl)-6'-methoxy-quinolin-3'-yl]-hept-6-enoic acid
(z) (E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl-2'-cyclopropyl-6'-methoxy-quinolin-3'-yl]-hept-6-enoic acid

The mevalonolactones of the formula I can be prepared by the following reaction scheme. The enal III

can also b prepared by proc ss s K, L and M.





In the above reaction scheme, R^1, R^2, R^3, R^4, R^5, R^6 and R^{12} are as defined above with respect to the formula I, and R^{21} and R^{22} independently represent C_{1-4} lower alkyl such as methyl, ethyl, n-propyl, i-propyl or n-butyl.

Step A represents a reduction reaction of the ester to a primary alcohol. Such reduction reaction can be conducted by using various metal hydrides, preferably diisobutylaluminium hydride, in a solvent such as tetrahydrofuran or toluene at a t mperature of from -20 to 20 • C, preferably from -10 to 10 • C.

Step B represents an oxidation reaction of the primary alcohol to an aldehyde, which can be conducted by using various oxidizing agents. Preferably, the reaction can be conducted by using pyridinium chlorochromate in methylene chloride at a temperature of from 0 to 25 • C, or by using oxalyl chloride, dimethyl sulfoxide and a tertiary amine such as triethylamine (Swern oxidation), or by using a sulfur trioxide

pyridine compl x.

Step C represents a synthesis of a 3-ethoxy-1-hydroxy-2-propene derivative, which can be prepared by reacting a compound V to lithium compound which has been preliminarily formed by treating cis-1-ethoxy-2-(tri-n-butylstannyl)ethylen with butyl lithium in tetrahydrofuran.

As the reaction temperature, it is preferred to employ a low temperature at a level of from -60 to -78 • C.

Step D represents a synthesis of an enal by acidic hydrolysis. As the acid catalyst, it is preferred to employ p-toluene sulfonic acid, hydrochloric acid or sulfuric acid, and the reaction may be conducted in a solvent mixture of water and tetrahydrofuran or ethanol at a temperature of from 10 to 25 • C. The 3-ethoxy-1-hydroxy-2-propene derivative obtained in Step C can be used in Step D without purification i.e. by simply removing tetra-n-butyl tin formed simultaneously.

Step E represents a double anion condensation reaction between the enal III and an acetoacetate. Such condensation reaction is preferably conducted by using sodium hydride and n-butyl lithium as the base in tetrahydrofuran at a temperature of from -80 to 0 • C, preferably from -30 to -10 • C.

Step F represents a reduction reaction of the carbonyl group, which can be conudcted by using a metal hydride, preferably sodium borohydride in ethanol at a temperature of from -10 to 25 • C, preferably from -10 to 5 • C.

Further, the reduction reaction may be conducted by using zinc borohydride in dry ethyl ether or dry tetrahydrofuran at a temperature of -100 to 25 • C, preferably from -80 to -50 • C.

Step G is a step for hydrolyzing the ester. The hydrolysis can be conducted by using an equimolar amount of a base, preferably potassium hydroxide or sodium hydroxide, in a solvent mixture of water and methanol or ethanol at a temperature of from 10 to 25 • C. The free acid hereby obtained may be converted to a salt with a suitable base.

Step H is a step for forming a mevalonolactone by the dehydration reaction of the free hydroxy acid I-2. The dehydration reaction can be conducted in benzene or toluene under reflux while removing the resulting water or by adding a suitable dehydrating agent such as molecular sieve.

Further, the dehydration reaction may be conducted in dry methylene chloride by using a lactone-forming agent such as carbodiimide, preferably a water soluble carbodiimide such as N-cyclohexyl-N'-[2'-(methylmorpholinium)ethyl]carbodiimide p-toluene sulfonate at a temperature of from 10 to 35 • C, preferably from 20 to 25 • C.

Step J represents a reaction for hydrogenating the double bond connecting the mevalonolactone moiety and the quinoline ring. This hydrogenation reaction can be conducted by using a catalytic amount of palladium-carbon or rhodium-carbon in a solvent such as methanol, ethanol, tetrahydrofuran or acetonitrile at a temperature of from 0 to 50 • C, preferably from 10 to 25 • C.

Step K represents a reaction for the synthesis of an α,β-unsaturated carboxylic acid ester, whereby a trans-form α,β-unsaturated carboxylic acid ester can be obtained by a so-called Horner-Wittig reaction by using an alkoxycarbonylmethyl phosphonate. The reaction is conducted by using sodium hydride or potassium t-butoxide as the base in dry tetrahydrofuran at a temperature of from -30 to 0 • C, preferably from -20 to -15 • C.

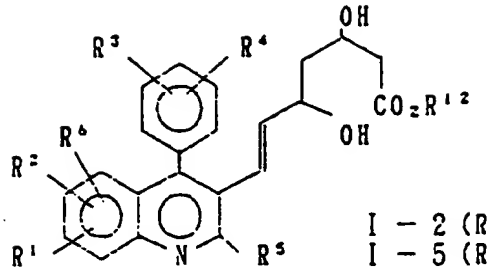
Step L represents a reduction reaction of the α,β-unsaturated carboxylic acid ester to an allyl alcohol. This reduction reaction can be conducted by using various metal hydrides, preferably diisobutylaluminium-hydride, in a solvent such as dry tetrahydrofuran or toluene at a temperature of from -10 to 10 • C, preferably from -10 to 0 • C.

Step M represents an oxidation reaction of the allyl alcohol to an enal. This oxidation reaction can be conducted by using various oxidizing agents, particularly active manganese dioxide, in a solvent such as tetrahydrofuran, acetone, ethyl ether or ethyl acetate at a temperatrue of from 0 to 100 • C, preferably from 15 to 50 • C.

Step N represents a reaction for the synthesis of an α,β-unsaturated ketone by the selective oxidation of the dihydroxy carboxylic acid ester. This reaction can be conducted by using activated manganese dioxide in a solvent such as ethyl ether, tetrahydrofuran, benzene or toluene at a temperature of from 20 to 80 • C, preferably from 40 to 80 • C.

In addition to the compounds disclosed in Examples given hereinafter, compounds of the formulas I-2 and I-5 given in Table 1 can be prepared by the process of the present invention. In Table 1, i- means iso, sec- means secondary and c- means cyclo. Likewise, Me means methyl, Et means ethyl, Pr means propyl, Bu means butyl, Pent means pentyl, Hex means hexyl and Ph means phenyl.

Table 1



I – 2 (R^{12}=H)
I – 5 (R^{12}=Na)

R^1	R^2	R^3	R^4	R^5	R^6
6–OMe	H	H	H	i–Pr	H
6–OMe	H	4-F	H	i–Pr	H
6–Br	H	4–F	H	i–Pr	H
6–Me	8–Me	4–F	H	i–Pr	H
7–OMe	8–OMe	4–F	H	i–Pr	H
6–Br	H	2–F	H	i–Pr	H
6,7 		4–F	H	i–Pr	H
H	H	4–F	H		H
H	H	4–Ph	H	i–Pr	H
6-Cℓ	H	4–F	H	c-Pr	H
6-Cℓ	H	4–F	H	sec-Bu	H
6-OCH_2Ph	H	4–F	H	i-Pr	H
H	H	4–F	H	i-Bu	H
H	H	4–F	H	c-Pent	H
6-Cℓ	H	4–F	H	c-Pent	H
6-Me_2N	H	4–F	H	i-Pr	H

R^1	R^2	R^3	R^4	R^5	R^6
6-Me	H	4 — F	H	c — Pr	H
6-i-Pr	H	4 — F	H	i-Pr	H
7-Me	H	4 — F	H	c — Pr	H
6-OMe	H	4 — F	H	c — Pr	H
6-Br	H	4 — F	H	c — Pr	H
6-i-Pr	H	4 — F	H	c — Pr	H
6-Cℓ	8-Cℓ	4 — F	H	c — Pr	H
H	H	4 — F	H	c-Bu	H
H	H	4 — F	H	c-Hex	H
6-OMe	7-OMe	H	H	i-Pr	H
6-OMe	7-OMe	4-Cℓ	H	i-Pr	H
6-OMe	7-OMe	H	H	c-Pr	H
6-OMe	7-OMe	4-Cℓ	H	c-Pr	H
6-OMe	7-OMe	4-F	H	c-Pr	H

R^1	R^2	R^3	R^4	R^5	R^6
6-Me	H	H	H	i-Pr	H
6-Me	H	4-Cℓ	H	i-Pr	H
6-Me	H	H	H	c-Pr	H
6-Me	H	4-Cℓ	H	c-Pr	H
6-Me	H	4-F	H	c-Pr	H
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6-Cℓ	H	4-Cℓ	H	i-Pr	H
6-Cℓ	H	H	H	c-Pr	H
6-Cℓ	H	4-Cℓ	H	c-Pr	H
6-Cℓ	H	4-F	H	c-Pr	H
H	H	H	H	i-Pr	H
H	H	4-Cℓ	H	i-Pr	H
H	H	H	H	c-Pr	H
H	H	4-Cℓ	H	c-Pr	H
H	H	4-F	H	c-Pr	H

Further, pharmaceutically acceptable salts such as potassium salts or esters such as ethyl esters or methyl esters of these compounds can be prepared in the same manner.

The compounds of the present invention exhibit high inhibitory activities against the cholesterol biosynthesis wherein HMG-CoA reductase acts as a rate limiting enzyme, as shown by the test results given hereinafter, and thus are capable of suppressing or reducing the amount of cholesterol in blood as lipoprotein. Thus, the compounds of the present invention are useful as curing agents against hyperlipidemia, hyperlipoproteinemia and atheroscleosis.

They may be formulated into various suitable formulations depending upon the manner of the administration. The compounds of the present invention may be administered in the form of free acids or in the form of physiologically hydrolyzable and acceptable esters or lactones, or pharmaceutically acceptable salts.

The pharmaceutical composition of the present invention is preferably administered orally in the form of the compound of the present invention per se or in the form of powders, granules, tablets or capsules formulated by mixing the compound of the present invention with a suitable pharmaceutically acceptable carrier including a binder such as hydroxypropyl cellulose, syrup, gum arabic, gelatin, sorbitol, tragacanth gum, polyvinyl pyrrolidone or CMC-Ca, an excipient such as lactose, sugar, corn starch, calcium phosphate, sorbitol, glycine or crystal cellulose powder, a lubricant such as magnesium stearate, talk, polyethylene glycol or silica, and a disintegrator such as potato starch.

However, the pharmaceutical composition of the present invention is not limited to such oral administration and it is applicable for parenteral administration. For example, it may be administered in the form of e.g. a suppository formulated by using oily base material such as cacao butter, polyethylene glycol, lanolin

or fatty acid triglycerid , a transdermal therapeutic base formulated by using liquid paraffin, white vaseline, a higher alcohol, Macrogol ointment, hydrophilic ointment or hydro-gel base material, an injection formulation formulated by using one or more materials selected from the group consisting of polyethylene glycol, hydro-gel base material, distill d wat r, distilled wat r for injection and xcipi nt such as lactos or corn starch, or a formulation for administration through mucous membranes such as an ocular mucous membrane, a nasal mucous membrane and an oral mucous membrane.

Further, the compounds of the present invention may be combined with basic ion-exchange resins which are capable of binding bile acids and yet not being absorbed in gastraintestinal tract.

The daily dose of the compound of the formula I is from 0.05 to 500 mg, preferably from 0.5 to 50 mg for an adult. It is administered from once to three times per day. The dose may of course be varied depending upon the age, the weight or the condition of illness of the patient.

The compounds of the formulas II to VII are novel, and they are important intermediates for the preparation of the compounds of the formula I. Accordingly, the present invention relates also to the compounds of the formulas II to VII and the processes for their production.

Now, the present invention will be described in further detail with reference to Test Examples for the pharmacological activities of the compounds of the present invention, their Preparation Examples and Formulation Examples. However, it should be understood that the present invention is by no means restricted by such specific Examples.

PHARMACOLOGICAL TEST EXAMPLES

Test A: Inhibition of cholesterol biosynthesis from acetate in vitro

Enzyme solution was prepared from liver of male Wistar rat billialy cannulated and discharged bile for over 24 hours. Liver was cut out at mid-dark and microsome and supernatant fraction which was precipitable with 40-80% of saturation of ammonium sulfate (sup fraction) were prepared from liver homogenate according to the modified method of Knauss et. al.; Kuroda, M., et. al., Biochim. Biophys. Acta, 489, 119 (1977). For assay of cholesterol biosynthesis, microsome (0.1 mg protein) and sup fraction (1.0 mg protein) were incubated for 2 hours at 37 °C in 200 µl of the reaction mixture containing ATP; 1 mM, Glutathione; 6 mM, Glucose-1-phosphate; 10 mM, NAD; 0.25 mM, NADP; 0.25 mM, CoA; 0.04 mM and 0.2 mM [2-^{14}C]sodium acetate (0.2 µCi) with 4 µl of test compound solution dissolved in water or dimethyl sulfoxide. To stop reaction and saponify, 1 ml of 15% EtOH-KOH was added to the reactions and heated at 75 °C for 1 hour. Nonsaponifiable lipids were extracted with petroleum ether and incorporated ^{14}C radioactivity was counted. Inhibitory activity of compounds was indicated with IC50.

Test B: Inhibition of cholesterol biosynthesis in culture cells

Hep G2 cells at over 5th passage were seeded to 12 well plates and incubated with Dulbecco's modified Eagle (DME) medium containing 10% of fetal bovine serum (FBS) at 37 °C, 5% CO_2 until cells were confluent for about 7 days. Cells were exposed to the DME medium containing 5% of lipoprotein deficient serum (LpDS) prepared by ultracentrifugation method for over 24 hours. Medium was changed to 0.5 ml of fresh 5% LpDS containing DME before assay and 10 µl of test compound solution dissolved in water or DMSO were added. 0.2 µCi of [2-^{14}C]sodium acetate (20 µl) was added at O hr(B-1) or 4 hrs(B-2) after addition of compounds. After 4 hrs further incubation with [2-^{14}C]sodium acetate, medium was removed and cells were washed with phosphate buffered saline(PBS) chilled at 4 °C. Cells were scraped with rubber policeman and collected to tubes with PBS and digested with 0.2 ml of 0.5 N KOH at 37 °C. Aliquot of digestion was used for protein analysis and remaining was saponified with 1 ml of 15% EtOH-KOH at 75 °C for 1 hour. Nonsaponifiable lipids were extracted with petroleum ether and ^{14}C radioactivity was counted. Counts were revised by cell protein and indicated with DPM/mg protein. Inhibitory activity of compounds was indicated with IC50.

Test C: Inhibition of cholesterol biosynthesis in vivo

Male Sprague-Dawley rats weighing about 150 g were fed normal Purina chow diet and water ad libitum, and exposed to 12 hours light/12 hours dark lighting pattern (2:00 PM - 2:00 AM dark) prior to use for in vivo inhibition test of cholesterol biosynthesis. Animals were separated groups consisting of five rats as to be average mean body weight in each groups. Test compounds at dosage of 0.02-0.2 mg/kg body weight (0.4 ml/100 g body weight), were dissolved in water or suspended or in 0.5% methyl cellulose and

orally administered at 2-3 hours before mid-dark (8:00 PM), while cholest rol biosynthesis reach s to maximum in rats. As control, rats were orally administer d only water or vehicle. At 90 minutes after sample administration, rats were injected intrap ritoneally with 10 μCi of [2-^{14}C]sodium acetate at volume of 0.2 ml per one. 2 Hours lat r, blood sampl s w r obtained and serum were separat d imm diately. Total lipids were extracted according to the method of Folch et al. and saponified with EtOH-KOH. Nonsaponifiable lipids were extracted with petroleum ether and radio activity incorporated into nonsaponifiable lipids was counted.

Inhibitory activity was indicated as percent decrease of counts in testing groups (DPM/2 ml serum/2 hours) from that in control group.

With respect to the compounds of the present invention, the inhibitory activities against the cholesterol biosynthesis in which HMG-CoA reductase serves as a rate limiting enzyme, were measured by the above Test A and B. The results are shown in Tables, 2, 2-2, 3 and 3-2. Further, the results of the measurements by Test C are also presented.

Table 2

Inhibitory activities by Test A	
Compound	IC_{50} (molar concentration)
(Compounds of the present invention)	
I-13	1.25×10^{-7}
I-51	1.0×10^{-8}
I-52	7.1×10^{-8}
I-53	1.9×10^{-7}
(Reference compounds)	
Mevinolin	1.4×10^{-8}
CS-514	9.0×10^{-9}

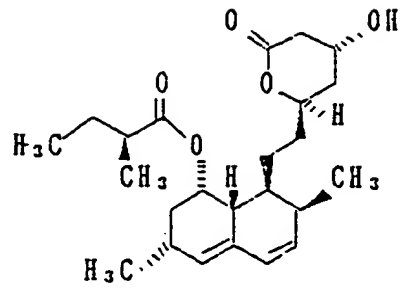
In Table 2-2, the relative activities are shown based on the activities of CS-514 being evaluated to be 1.

Table 2-2

Relative activities by Test A	
Compound	Relative activities
(Comounds of the present invention)	
I-16	1.75
I-116	2.25
I-117	0.37
I-120	3.21
I-522	0.76

Structures of reference compounds:

(1) Mevinolin



(2) CS-514

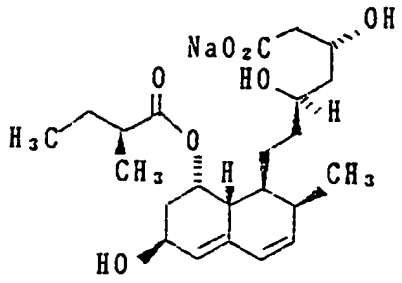


Table 3

Inhibitory activities by Test B-1	
Compound	IC_{50} (molar concentration)
(Compound of the present invention)	
I-51	1×10^{-7}
(Reference compound)	
CS-514	3.5×10^{-7}

In Table 3-2, the relative activities are shown based on the activities of CS-514 being evaluated to be 1.

Table 3-2

Relative activities by Test B-1	
Compound	Relative activities
I-116	19.4
I-520	20.0
II-20	20.8

Results of th measurement of th inhibitory activities by T st C

Th percent decr ase of counts after the oral administration of 0.05 mg/kg of compound I-520 was 55% relative to the m asur d value of th control group. Th percent d cr ase of counts after th oral administration of 10 mg/kg of CS-514 was 55% under the same condition. The compounds of the present invention exhibited activities superior to the reference compound such as CS-514 or Mevinolin in Test A, and exhibited activities superior to CS-514 in Tests B and C.

Test D: Acute toxicity

A 0.5% CMC suspension of a test compound was orally administered to ICR male mice (group of three mice). The acute toxicity was determined based on the mortality after seven days. With compound I-57, I-58, I-59, I-511, I-512, I-513, I-514, I-515, I-517 and I-523 of the present invention, the mortality was 0% even when they were orally administered in an amount of 1000 mg/kg.

EXAMPLE 1

Ethyl (E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-quinolin-3'-yl]-hept-6-enoate (compound I-11) (prepared by steps of Example 1-a through Example I-q)

EXAMPLE 1-a: Ethyl 4-(4'-fluorophenyl)-2-(1'-methylethyl)-quinolin-3-yl-carboxylate (compound VII-1)

The synthesis was conducted in accordance with the method disclosed in J. Org. Chem., 2899 (1966).

6.45 g (0.03 mol) of 2-amino-4'-fluorobenzophenone, 5.53 g (0.035 mol) of ethyl isobutyrylacetate and 0.1 ml of conc. sulfuric acid were dissolved in 30 ml of glacial acetic acid, and the mixture was heated at 100 • C for about 10 hours. After confirming the substantial disappearance of 2-amino-4'-fluorobenzophenone by thin layer chromatography, the reaction solution was cooled to room temperature, and a mixture of 45 ml of conc. aqueous ammonia and 120 ml of water cooled with ice, was gradually added thereto. A separated oily substance was solidified when left to stand overnight in a refrigerator. This solid was recrystallized from a small amount of ethanol to obtain 6.47 g (55%) of white powder. Melting point: 68-70.5 • C

EXAMPLE 1-b: 4-(4'-fluorophenyl)-3-hydroxymethyl-2-(1'-methylethyl)-quinoline (compound VI-1)

5.4 g (0.016 mol) of compound VII-1 was dissolved in dry toluene under a nitrogen atmosphere and cooled in ice bath to 0 • C. To this solution, 40 ml of a 16 wt% diisobutylaluminium hydride-toluene solution was dropwise added, and the mixture was stirred at 0 • C for two hours. After confirming the complete disappearance of compound VII-1 by thin layer chromatography, a saturated ammonium chloride solution was added thereto at 0 • C to terminate the reaction. Ethyl ether was added to the reaction mixture, and the organic layer was separated. A gelled product was dissolved by an addition of an aqueous sodium hydroxide solution and extracted anew with ethyl ether. The ethyl ether extracts were put together, dried over anhydrous magnesium sulfate and filtered. The solvent was distilled off. The residual oil underwent crystallization when left to stand. It was recrystallized from ethyl acetate-n-hexane to obtain 3.3 g of white crystals. Yield: 70%. Melting point: 136-137 • C.

EXAMPLE 1-c: 4-(4'-fluorophenyl)-2-(1'-methylethyl)-quinolin-3-yl-carboxyaldehyde (compound V-1)

2.0 g (9.3 mmol) of pyridinium chlorochromate and 0.4 g of anhydrous sodium acetate was suspended in 10 ml of dry dichloromethane. To this suspension, a solution obtained by dissolving 1 g (3.4 mmol) of compound VI-1 in 10 ml of dry dichloromethane, was immediately added at room temerature. The mixture was stirred for one hour. Then, 100 ml of ethyl ether was added thereto, and the mixture was throughly mixed. The reaction mixture was filtered under suction through a silica gel layer. The filtrate was dried under reduced pressure. The residue was dissolved in the isopropyl ether, and insoluble substances were filtered off. The filtrate was again dried under reduced pressure, and the residue was recrystallized from diisopropyl ether to obtain 0.7 g (Yield: 70%) of slightly yellow prism crystals. Melting point: 124-126 • C.

EXAMPLE 1-d: 3-(3'-ethoxy-1'-hydroxy-2'-propenyl)-4-(4'-fluorophenyl)-2-(1'-methylethyl)-quinoline (compound IV-1)

1.13 g (3.13 mmol) of cis-1- thoxy-2-(tri-n-butylstannyl)ethylene was dissolved in 8 ml of dry tetrahydrofuran, and the solution was cooled to -78 • C in a nitrogen stream. To this solution, 2 ml (3.2 mmol) of a 15 wt% n-butyllithium-n-hexane solution was dropwise added. The mixture was stirred for 45 minutes. Then, a solution prepared by dissolving 0.76 g (2.6 mmol) of compound V-1 in 10 ml of dry tetrahydrofuran was dropwise added thereto. The reaction mixture was stirred at -78 • C for two hours. Then, 2 ml of a saturated ammonium chloride solution was added thereto to terminate the reaction. The organic layer was extracted with diethyl ether, and the diethyl ether extract was washed with a saturated sodium chloride aqueous solution and dried over anhydrous magnesium sulfate. The solvent was distilled off under reduced pressure. The residue was separated with n-hexane and acetonitrile. The solvent was distilled off under reduced pressure from the acetonitrile layer, and an oily substance thereby obtained was purified by silica gel column chromatography (eluent: 2.5% methanol-chloroform) to obtain 0.91 g of the desired compound in a purified oily form.

H-MNR ($CDCl_3$) δ ppm:

1.1(t,3H,7Hz) 1.37(d,6H,J = 7Hz) 3.7(m,1H) 3.7(q,2H,J = 7Hz) 4.75(t,1H,7Hz) 5.7(m,1H) 5.95(m,1H) 7.05-8.2(m,8H)

EXAMPLE 1-e: (E)-3-[4'-(4''-fluorophenyl)-2'-(1''-methylethyl)-quinolin-3'-yl]propenaldehyde (compound III-1)

0.91 g of compound IV-1 was dissolved in 20 ml of tetrahydrofuran, and 5 ml of water and 100 mg of p-toluenesulfonic acid were added thereto. The mixture was stirred at room temperature for 24 hours. The reaction solution was extracted with diethyl ether a few times. The extracts were washed with a saturated sodium chloride aqueous solution and dried over anhydrous magnesium sulfate. Then, the solvent was distilled off. The residue was purified by silica gel column chromatography (eluent: chloroform) to obtain the desired product as white prism crystals. 0.4 g (50%). Melting point: 127-128 • C.

EXAMPLE 1-f: Ethyl (E)-7-[4'-(4''-fluorophenyl)-2'-(1''-methylethyl)-quinolin-3'-yl]-5-hydroxy-3-oxohepto-6-enoate (compound II-1)

50 mg of 60% sodium hydride was washed with dry petroleum ether and dried under a nitrogen stream, and then suspended in 5 ml of dry tetrahydrofuran. The suspension was cooled to -15 • C in a nitrogen atmosphere. Then, 120 mg (0.92 mmol) of ethyl acetoacetate was dropwise added thereto, and the mixture was stirred for 15 minutes. Then, 0.6 ml (0.92 mmol) of a 15 wt% n-butyllithium-n-hexane solution was dropwise added thereto, and the mixture was stirred for 30 minutes. Then, a solution prepared by dissolving 160 mg (0.5 mmol) of compound III-1 in dry tetrahydrofuran, was dropwise added thereto, and the mixture was stirred for one hour. To the reaction mixture, 1 ml of a saturated ammonium chloride aqueous solution was added at -15 • C. Then, the mixture was extracted three times with diethyl ether. The diethyl ether solution was washed with a saturated sodium chloride aqueous solution and dried over anhydrous magnesium sulfate. The solution was evaporated to dryness under reduced pressure. The residue was recrystallized from diisopropyl ether to obtain 130 mg (yield: 59%) of white crystals. Melting point: 99-101 • C.

EXAMPLE 1-g: Ethyl (E)-3,5-dihydroxy-7-[4'-(4''-fluorophenyl)-2'-(1''-methylethyl)-quinolin-3'-yl]-hept-6-enoate (compound I-11)

110 mg (0.245 mmol) of compound II-1 was dissolved in 5 ml of ethanol in a nitrogen atmosphere, and the solution was cooled 0 • C. Then, 10 mg (0.263 mmol) of sodium borohydride was added, and the mixturer was stirred for one hour. Then, 1 ml of a 10% hydrochloric acid aqueous solution was added thereto, and the mixture was extracted three times with ethyl ether. The ethyl ether solution was washed with a saturated sodium chloride aqueous solution and dried over anhydrous magnesium sulfate. Then, the solution was evaporated to dryness under reduced pressure. The residual oil was purified by silica gel column chromatography (eluent: 5% methanol-chloroform) to obtain the desired product as a pure colorless oily substance. 70 mg (Yield: 64%)

H-NMR ($CDCl_3$) δ ppm:

1.30(t,3H,J = 8Hz) 1.39(d,6H,J = 8Hz) 1.4-1.8(m,2H) 2.42(d,2H,J = 7Hz) 3.0-3.8 (m,2H) 3.50(m,1H) 3.9-4.6(m,2H) 4.20(q,2H,J = 8Hz) 5.35(m,1H) 6.59(m,1H)

7.10-8.18(m,8H)

EXAMPLE 2

Sodium salt of (E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-quinolin-3'-yl]-hept-6-enoic acid (compound I-51)

60 mg (0.133 mmol) of compound I-11 was dissolved in 3 ml of ethanol. Then, 0.26 ml of a 0.5 N sodium hydroxide aqueous solution was dropwise added thereto. The mixture was stirred at room temperature for further one hour, and ethanol was distilled off under reduced pressure. Then, 5 ml of water was added thereto, and the mixture was extracted with ethyl ether. The aqueous layer was freeze-dried to obtain 40 mg (67%) of hygroscopic white powder. Melting point: 207-209 • C (decomposed).

EXAMPLE 3

(E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-quinolin-3'-yl]-hept-6-enoic acid (compound I-21)

110 mg (0.244 mmol) of compound I-11 was dissolved in 10 ml of ethanol. Then, 0.79 ml of a 0.5 N sodium hydroxide aqueous solution was dropwise added thereto. The mixture was stirred at room temperature for further one hour, and ethanol was distilled off under reduced pressure. Then, 10 ml of water was added thereto, and the mixture was extracted with ethyl ether. The aqueous layer was weakly acidified (pH 4) with a dilute hydrochloric aqueous solution and extracted three times with ethyl ether. The ethyl ether layers were put together and dried over anhydrous magnesium sulfate. Then, the solvent was distilled off under reduced pressure to obtain 90 mg of slightly yellow oily substance.

H-NMR ($CDCl_3$) δ ppm:

1.36(d,6H,J = 7Hz) 2.4(m,2H) 3.5(m,1H) 3.45(m,1H) 3.8-4.6(m,2H) 5.40-(dd,1H,J_1 = 19Hz,J_2 = 8Hz) 6.55 (d,1H,J = 19Hz) 7.0-8.3(m,8H)

EXAMPLE 4

(E)-6-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-quinolin-3'-ylethenyl]-4-hydroxy-3,4,5,6-tetrahydro-2H-pyran-2-one (compound I-31)

90 mg of compound I-21 was dissolved in 10 ml of dry toluene, and the solution was refluxed under heating for 3 hours by means of a Dean Stark apparatus.

Toluene was distilled off under reduced pressure, and the residual solid was recrystallized from diisopropyl ether to obtain 40 mg of colorless prism crystals. Melting point: 182-184 • C.

By silica gel thin chromatography, the product gave two absorption spots close to each other attributable to the diastereomers. (Developping solvent: 3% methanol-chloroform)

These diasteromers were separated and isolated by silica gel thin layer chromatography. [Developping solvent: t-BuOMe/hexane/acetone = 7/2/1 (v/v), Rf = 0.6 and 0.7 (obtained weight ratio: 1/2)]

Rf = 0.7: trans lactone

H-NMR ($CDCl_3$) δ ppm:

1.40(d,6H,J = 7Hz) 1.6(m,2H) 2.65(m,2H) 3.48(m,1H) 4.20(m,1H) 5.15(m,1H) 5.37(dd,1H,J_1 = 18Hz,J_2 = 7Hz) 6.68(d,1H,J = 19Hz) 7.1-8.2(m,8H)

Rf = 0.6: cis lactone

H-NMR ($CDCl_3$) δ ppm:

1.40(d,6H,J = 7Hz) 1.6(m,2H) 2.65(m,2H) 3.48(m,1H) 4.20(m,1H) 4.65(m,1H) 5.40(dd,1H,J_1 = 18Hz,J_2 = 7Hz) 6.66(m,1H) 7.0-8.2(m,8H)

EXAMPLE 5

6-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-quinolin-3'-ylethynyl]-4-hydroxy-3,4,5,6-tetrahydro-2H-pyran-2-one (compound I-41)

20 mg of a mixture of diastereomers of compound I-31 was dissolved in 5 ml of ethanol, and 10 mg of 5% palladium-carbon was added thereto. The mixture was stirred under a hydrogen atmosphere. After confirming the disappearance of the starting substance and the appearance of a new spot by thin layer chromatography, the palladium-carbon was filtered off, and ethanol was distilled off to obtain colorless oil.

This oil was purified by preparative thin layer chromatography to obtain 16 mg of the desired product as pure colorless oil.

MS(m/e): 408($M^+ + H$), 407(M^+), 366, 292, 278

In the same manner as in Example 1-a, compounds VII-2 to VII-27 were prepared. The physical properties of these compounds are shown in Table 4. (In the Table, R^1, R^2, R^3, R^4, R^5 and R^{21} correspond to the substitients of compound VII.)

Table 4 (Compounds in this Table are compounds of the formula VII wherein R^6 is hydrogen.)

Compound	R^1	R^2	R^3	R^4	R^5	R^{21}	m. p. (℃)
VII-2	H	H	4-F	H	CH_3	C_2H_5	121-122
VII-3	H	H	H	H	CH_3	C_2H_5	102-102.5
VII-4	H	H	H	H	i-Pr	C_2H_5	85-85.5
VII-5	6-Cℓ	H	H	H	CH_3	C_2H_5	100.5-101.5
VII-6	6-Cℓ	H	H	H	i-Pr	C_2H_5	105.5-106.5
VII-7	H	H	2-F	H	i-Pr	C_2H_5	101.0-102.0
VII-8	7-Me	H	H	H	i-Pr	C_2H_5	oil
VII-9	H	H	4-Cℓ	H	i-Pr	C_2H_5	134.0-136.5
VII-10	H	H	4-OMe	H	i-Pr	C_2H_5	88.0-89.0
VII-11	H	H	4-Me	H	i-Pr	C_2H_5	108.5-109.5
VII-12	6-Cℓ	H	2-Cℓ	H	i-Pr	C_2H_5	101.0-103.0
VII-13	H	H	4-CF_3	H	i-Pr	C_2H_5	117.5-119.0
VII-14	H	H	3-Me	4-F	i-Pr	C_2H_5	oil
VII-15	H	H	3-Me	5-Me	i-Pr	C_2H_5	oil
VII-16	6-OMe	7-OMe	4-F	H	i-Pr	C_2H_5	96.0-98.0
VII-17	H	H	4-F	H	C_2H_5	CH_3	139.0-139.5
VII-18	H	H	4-F	H	n-Pr	C_2H_5	oil
VII-19	6-Cℓ	H	4-F	H	i-Pr	C_2H_5	94.5-95.5
VII-20	H	H	4-F	H	c-Pr	CH_3	113.5-116.5
VII-21	H	H	4-OPh	H	i-Pr	C_2H_5	oil
VII-22	6-Cℓ	8-Cℓ	4-F	H	i-Pr	C_2H_5	96.0-98.0
VII-23	6-Cℓ	H	H	H	Ph	C_2H_5	118.8-119.5

Ⅶ-24	6-Cℓ	H	H	H	c-Pr	CH_3	97.0-98.5
Ⅶ-25	H	H	4-F	H	sec-Bu	CH_3	oil
Ⅶ-26	6-Me	H	4-F	H	i-Pr	C_2H_5	109.0-111.0
Ⅶ-27	6-OMe	7-OMe	4-F	H	c-Pr	CH_3	153.0-153.5

Ⅶ − 8

H-NMR (in $CDCℓ_3$) δ ppm :

0.92 (t, 3H, J = 7Hz), 1.41 (d, 6H, J = 6Hz)

2.47 (s, 3H), 3.27 (Heptaplet, 1H, J=6Hz)

3.96 (q, 2H, J = 7Hz), 7.0 − 7.8 (m, 8H)

Ⅶ − 14

H-NMR (in $CDCℓ_3$) δ ppm :

1.01 (t, 3H, J=7Hz), 1.42 (d, 6H, J=6Hz)

2.38 (s, 3H, J=3Hz), 3.25 (Heptaplet, 1H, J=6Hz)

4.04 (q, 2H, J=7Hz), 6.9 − 8.1 (m, 7Hz)

Ⅶ − 15

H-NMR (in $CDCℓ_3$) δ ppm :

0.97 (t, 3H, J=7Hz), 1.43 (d, 6H, J=6Hz)

2.29 (s, 6H), 3.25 (Heptaplet, 1H, J=6Hz)

4.00 (q, 2H, J=7Hz), 6.8 − 8.0 (m, 7H)

VII - 18

H-NMR (in $CDCl_3$) δ ppm :

0.98 (t, 3H, J=7Hz), 1.02 (t, 3H, J=7Hz)

1.6-2.3 (m, 2H), 2.8-3.1 (m, 2H)

4.03 (q, 2H, J=7Hz), 6.9-8.1 (m, 8H)

VII - 21

H-NMR (in $CDCl_3$) δ ppm :

1.03 (t, 3H, J=7Hz), 1.41 (d, 6H, J=6Hz)

3.25 (Heptaplet, 1H, J=6Hz), 4.05 (q, 2H, J=7Hz),

6.8-8.1 (m, 13H)

VII - 25

H-NMR (in $CDCl_3$) δ ppm :

0.97 (d, 6H, J=6Hz), 2.0~2.6 (m, 1H)

2.85 (d, 2H, J=7Hz), 3.51 (s, 3H),

6.8-8.1 (m, 8H)

In the same manner as in Example 1-b, compounds VI-2 to VI-27 were prepared. (In Table 5, R^1, R^2, R^3, R^4 and R^5 correspond to the substituents in compound VI.)

Tale 5 (Compounds in this Table are compounds of the formula VI wherein R^6 is hydrogen.)

Compound	R^1	R^2	R^3	R^4	R^5	m. p. (℃)
VI-2	H	H	p-F	H	CH_3	—
VI-3	H	H	H	H	CH_3	149-151
VI-4	H	H	H	H	i-Pr	130-130.5
VI-5	6-Cℓ	H	H	H	CH_3	139-141
VI-6	6-Cℓ	H	H	H	i-Pr	168-169
VI-7	H	H	2-F	H	i-Pr	140.5-142.0
VI-8	7-Me	H	H	H	i-Pr	155.0-157.0
VI-9	H	H	4-Cℓ	H	i-Pr	192.0-195.0
VI-10	H	H	4-OMe	H	i-Pr	186.0-188.5
VI-11	H	H	4-Me	H	i-Pr	161.0-164.0
VI-12	6-Cℓ	H	2-Cℓ	H	i-Pr	122.0 124.0
VI-13	H	H	4-CF_3	H	i-Pr	183.0-186.0
VI-14	H	H	3-Me	4-F	i-Pr	161.0-162.5
VI-15	H	H	3-Me	5-Me	i-Pr	137.0-138.0
VI-16	6-Me	7-OMe	4-F	H	i-Pr	164.0-165.0
VI-17	H	H	4-F	H	C_2H_5	141.5-143.5
VI-18	H	H	4-F	H	n-Pr	146.5-148.5
VI-19	6-Cℓ	H	4-F	H	i-Pr	171.0-172.0

VI-20	H	H	4-F	H	c-Pr	120-126
VI-21	H	H	4-OPh	H	i-Pr	153.0-154.0
VI-22	6-Cℓ	8-Cℓ	4-F	H	i-Pr	98.5-103
VI-23	6-Cℓ	H	H	H	Ph	171.5-172.5
VI-24	6-Cℓ	H	H	H	c-Pr	84.0-86.0
VI-25	H	H	4-F	H	sec-Bu	119.0-121.0
VI-26	6-Me	H	4-F	H	i-Pr	160.0-161.5
VI-27	6-OMe	7-OMe	4-F	H	c-Pr	162.0-163.0

In the same manner as in Example 1-c, compounds V-2 to V-27 were prepared. (In Table 6, R^1, R^2, R^3, R^4 and R^5 correspond to the substituents of compound of V.)

Table 6 (Compounds in this Table are compounds of the formula V wherein R^6 is hydrogen.)

Compound	R^1	R^2	R^3	R^4	R^5	m. p. (℃)
V-2	H	H	p-F	H	CH_3	125-128
V-3	H	H	H	H	CH_3	143-146
V-4	H	H	H	H	i-Pr	92-93
V-5	6-Cℓ	H	H	H	CH_3	220-222

V-6	6-Cℓ	H	H	H	i-Pr	140-140.5
V-7	H	H	2-F	H	i-Pr	121.5-124.0
V-8	7-Me	H	H	H	i-Pr	105.1-109.2
V-9	H	H	4-Cℓ	H	i-Pr	147.0-147.8
V-10	H	H	4-OMe	H	i-Pr	135.6-136.8
V-11	H	H	4-Me	H	i-Pr	119.4-120.4
V-12	6-Cℓ	H	2-Cℓ	H	i-Pr	105.8-106.9
V-13	H	H	4-CF_3	H	i-Pr	163.7-164.2
V-14	H	H	3-Me	4-F	i-Pr	161.1-108.1
V-15	H	H	3-Me	5-Me	i-Pr	120.8-122.3
V-16	6-OMe	7-OMe	4-F	H	i-Pr	164.4-165.2
V-17	H	H	4-F	H	C_2H_5	143.1-144.2
V-18	H	H	4-F	H	n-Pr	150.2-155.3
V-19	6-Cℓ	H	4-F	H	i-Pr	164.5-165.3
V-20	H	H	4-F	H	c-Pr	150.1-151.6
V-21	H	H	4-OPh	H	i-Pr	106.9-107.7
V-22	6-Cℓ	8-Cℓ	4-F	H	i-Pr	135.0-135.7
V-23	6-Cℓ	H	H	H	Ph	174.8-175.3
V-24	6-Cℓ	H	H	H	c-Pr	157.5-158.0
V-25	H	H	4-F	H	sec-Bu	125.0-126.5
V-26	6-Me	H	4-F	H	i-Pr	155.0-157.0
V-27	6-OMe	7-OMe	4-F	H	c-Pr	200.0-200.5

In the same manner as in Example 1-d, compounds IV-2 to IV-6 were prepared. (In Table 7, R^1, R^2, R^3, R^4 and R^5 correspond to the substituents of compound of IV.)

Table 7

(Compounds in this Tabl ar compounds of th formula IV wherein R^6 is hydrogen.)						
Compound	R^1	R^2	R^3	R^4	R^5	m. p. (°C)
IV - 2	H	H	4-F	H	CH_3	177-179
IV - 3	H	H	H	H	CH_3	-
IV - 4	H	H	H	H	i-Pr	-
IV - 5	6-Cℓ	H	H	H	CH_3	-
IV - 6	6-Cℓ	H	H	H	i-Pr	-

In the same manner as in Example 1-e, compounds III-2 to III-27 were prepared. (In Table 8, R^1, R^2, R^3, R^4 and R^5 correspond to the substituents of compound III.)

Table 8 (Compounds in this Table are compounds of the formula III wherein R^6 is hydrogen.)

Compound	R^1	R^2	R^3	R^4	R^5	m. p. (°C)
III-2	H	H	4-F	H	CH_3	194-196
III-3	H	H	H	H	CH_3	170-171.5
III-4	H	H	H	H	i-Pr	107-108.5
III-5	6-Cℓ	H	H	H	CH_3	192-194
III-6	6-Cℓ	H	H	H	i-Pr	125.5-127
III-7	H	H	2-F	H	i-Pr	80.1-80.2
III-8	7-Me	H	H	H	i-Pr	121.1-122.3
III-9	H	H	4-Cℓ	H	i-Pr	148.0-149.1
III-10	H	H	4-OMe	H	i-Pr	137.4-140.1
III-11	H	H	4-Me	H	i-Pr	111.6-113.1
III-12	6-Cℓ	H	2-Cℓ	H	i-Pr	83.8-84.5
III-13	H	H	4-CF_3	H	i-Pr	126.2-128.8

Ⅲ-14	H	H	3-Me	4-F	i-Pr	124.8-126.4
Ⅲ-15	H	H	3-Me	5-Me	i-Pr	117.6-120.3
Ⅲ-16	6-OMe	7-OMe	4-F	H	i-Pr	147.8-150.9
Ⅲ-17	H	H	4-F	H	C_2H_5	124.3-128.5
Ⅲ-18	H	H	4-F	H	n-Pr	117.8-121.5
Ⅲ-19	6-Cℓ	H	4-F	H	i-Pr	135.2-135.9
Ⅲ-20	H	H	4-F	H	c-Pr	141.3-144.1
Ⅲ-21	H	H	4-OPh	H	i-Pr	oil
Ⅲ-22	6-Cℓ	8-Cℓ	4-F	H	i-Pr	117-122
Ⅲ-23	6-Cℓ	H	H	H	Ph	142.8-144.3
Ⅲ-24	6-Cℓ	H	H	H	c-Pr	161.0-161.5
Ⅲ-25	H	H	4-F	H	sec-Bu	78.0-81.0
Ⅲ-26	6-Me	H	4-F	H	i-Pr	137.0-137.5
Ⅲ-27	6-OMe	7-OMe	4-F	H	c-Pr	189.5-191.0

Ⅲ－22

H-NMR(in $CDCℓ_3$) δ ppm :

1.40(d,6H,J=7Hz), 3.44(Heptaplet,1H,J=7Hz)

5.93(dd,1H,J=8Hz,J=16Hz), 6.8-8.1(m,14H)

9.34(d,1H,J=8Hz)

In the same manner as in Example 1-f, compounds II-2 to II-27 were prepared. (In Table 9, R^1, R^2, R^3, R^4 and R^5 correspond to the substituents of compound II.)

Table 9 (Compounds in this Table are compounds of the formula of II wherein R^6 is hydrogen.)

Compound	R^1	R^2	R^3	R^4	R^5	R^{12}	m. p. (℃)
II-2	H	H	p-F	H	CH_3	C_2H_5	oil
II-3	H	H	H	H	CH_3	C_2H_5	105-106
II-4	H	H	H	H	i-Pr	C_2H_5	88.5-90.5
II-5	6-Cℓ	H	H	H	CH_3	C_2H_5	77-82
II-6	6-Cℓ	H	H	H	i-Pr	C_2H_5	96-98
II-7	H	H	2-F	H	i-Pr	C_2H_5	oil
II-8	7-Me	H	H	H	i-Pr	C_2H_5	68.5-74.0
II-9	H	H	4-Cℓ	H	i-Pr	C_2H_5	91.0-94.0
II-10	H	H	4-OMe	H	i-Pr	C_2H_5	78.0-78.5
II-11	H	H	4-OMe	H	i-Pr	C_2H_5	75.0-78.0
II-12	6-Cℓ	H	2-Cℓ	H	i-Pr	C_2H_5	oil
II-13	H	H	4-CF_3	H	i-Pr	C_2H_5	78.0-83.0
II-14	H	H	3-Me	4-F	i-Pr	C_2H_5	66.0-71.0
II-15	H	H	3-Me	5-Me	i-Pr	C_2H_5	oil

Ⅱ-16	6-OMe	7-OMe	4-F	H	i-Pr	C_2H_5	83.0 -90.0
Ⅱ-17	H	H	4-F	H	C_2H_5	C_2H_5	94.0 -97.0
Ⅱ-18	H	H	4-F	H	n-Pr	C_2H_5	oil
Ⅱ-19	6-Cℓ	H	4-F	H	i-Pr	C_2H_5	111.0- 113.5
Ⅱ-20	H	H	4-F	H	c-Pr	C_2H_5	91.0 -93.0
Ⅱ-21	H	H	4-OPh	H	i-Pr	C_2H_5	121.0- 125.0
Ⅱ-22	6-Cℓ	8-Cℓ	4-F	H	i-Pr	C_2H_5	oil
Ⅱ-23	6-Cℓ	H	H	H	Ph	C_2H_5	oil
Ⅱ-24	6-Cℓ	H	H	H	c-Pr	C_2H_5	69.0 -71.0
Ⅱ-25	H	H	4-F	H	sec-Bu	C_2H_5	oil
Ⅱ-26	6-Me	H	4-F	H	i-Pr	C_2H_5	oil
Ⅱ-27	6-OMe	7-OMe	4-F	H	c-Pr	C_2H_5	oil

Ⅱ − 7

H-NMR(in $CDC\ell_3$) δ ppm :

1.21(t,3H,J=7Hz), 1.32(d,6H,J=6Hz)

2.2-2.4(m,2H), 2.5-2.7(m,1H)

3.28(s,1H), 3.34(Heptaplet,1H,J=6Hz)

4.08(q,2H,J=7Hz), 4.3-4.6(m,1H)

5.28(dd,1H,J=6Hz,J=15Hz),

6.53(dd,1H,J=1.5Hz,J=15Hz), 6.9-8.0(m,8H)

II − 1 2

H-NMR(in $CDCl_3$) δ ppm :

1.25(t,3H,J=7Hz), 1.33(d,6H,J=6Hz)

2.2-2.4(m,2H), 2.5-2.8(m,1H)

3.32(s,2H), 3.38(Heptaplet, 1H, J=6Hz)

4.13(q,2H,J=7Hz), 4.2-4.6(m,1H)

5.34(dd,1H,J=6Hz,J=15Hz),

6.53(dd,1H,J=1.5Hz,J=15Hz), 7.0-8.0(m,7H)

II − 1 5

H-NMR(in $CDCl_3$) δ ppm :

1.23(t,3H, J=7Hz), 1.35(d,6H,J=6Hz)

2.2-2.4(m,2H), 2.31(s,6H)

2.6-2.8(m,1H), 3.32(s,2H)

3.35(Heptaplet,1H,J=6Hz), 4.12(q,2H,J=7Hz)

4.3-4.7(m,1H), 5.30(dd,1H,J=6Hz,J=16Hz)

6.51(dd,1H,J=1Hz,J=16Hz), 6.7-8.0(m,7H)

II − 1 8

H-NMR (in $CDCl_3$) δ ppm :

1.00(t,3H,J=7Hz), 1.26(t,3H,J=7Hz)

1.6-2.3(m,2H), 2.42(d,2H,J=6Hz)

2.6-3.2(m,3H), 3.35(s,2H)

4.11(q,2H,J=7Hz), 4.3-4.7(m,1H)

5.27(dd,1H,J=6Hz,J=16Hz)

6.46(dd,1H,J=1.5Hz,J=16Hz), 6.9-8.0(m,8H)

II－22

H-NMR(in $CDCl_3$) δ ppm :

1.26(t,3H,J=7Hz), 1.33(d,6H,J=6Hz)

2.43(d,2H,J=6Hz), 2.6-2.9(m,1H)

3.36(s,2H), 3.44 (Heptaplet,1H,J=6Hz)

4.13(q,2H,J=7Hz), 4.3-4.7(m,1H)

5.30(dd,1H,J=6Hz,J=16Hz),

6.53(dd,1H,J=1.5Hz,J=16Hz), 7.0-7.6(m,6H)

II－23

H-NMR(in $CDCl_3$) δ ppm :

1.23(t,3H,J=7Hz), 2.21(d,2H,J=6Hz)

2.4-2.6(m,1H), 3.25(s,2H)

4.09(q,2H,J=7Hz), 4.1-4.4(m,1H)

5.08(dd,1H,J=6Hz,J=16Hz),

6.26(dd,1H,J=1.5Hz,J=16Hz), 7.0 ～8.0

(m,13H)

Ⅱ－２５

H-NMR(in $CDCl_3$) δ ppm :

0.96(d,6H,J=6Hz), 1.26(t,3H,J=7Hz),
1.8-2.4(m,1H), 2.43(d,2H,J=6Hz),
2.6-2.9(m,1H), 2.88(d,2H,J=7Hz),
3.36(s,2H), 4.14(q,2H,J=7Hz),
4.3-4.7(m,1H), 5.0-5.5(m,1H),
6.3-6.7(m,1H), 6.9-8.1(m,8H)

Ⅱ－２６

H-NMR(in $CDCl_3$) δ ppm :

1.25(t,3H,J=7Hz), 1.32(d,6H,J=6Hz),
2.32(s,3H), 2.39(d,2H,J=7Hz),
2.6-3.1(m,1H), 3.36(s,2H),
3.41(Heptaplet,1H,J=6Hz),
4.11(q,2H,J=7Hz), 4.3-4.7(m,1H),
5.0-5.5(m,1H), 6.3-6.7(m,1H),
6.8-7.9(m,7H)

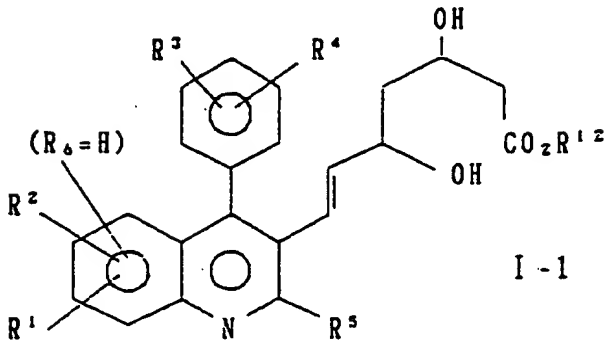
Ⅱ－２７

H-NMR(in $CDCl_3$) δ ppm :

0.8-1.5(m,4H), 1.26(t,3H,J=7Hz),
2.0-2.9(m,4H), 3.42(s,2H), 3.71(s,3H),
4.00(s,3H), 4.20(q,2H,J=7Hz),
4.4-4.8(m,1H), 5.3-5.8(m,1H),
6.4-6.9(m,1H), 6.58(s,1H),
7.0-7.5(m,5H)

In the sam manner as in Example 1-g, compounds I-12 to I-127 were prepared.

Table 10



I-1

Compound	R1	R2	R3	R4	R5	R12	m. p. (°C) Mass spectrum
I-12	H	H	4-F	H	CH_3	C_2H_5	oil
						M/e	423, 292
							264, 249
I-13	H	H	H	H	CH_3	C_2H_5	92-105
I-14	H	H	H	H	i-Pr	C_2H_5	97-100
I-15	6-Cℓ	H	H	H	CH_3	C_2H_5	oil

I-16	6-Cℓ	H	H	H	i-Pr	C_2H_5	oil
I-17	H	H	2-F	H	i-Pr	C_2H_5	oil
I-18	7-Me	H	H	H	i-Pr	C_2H_5	oil
I-19	H	H	4-Cℓ	H	i-Pr	C_2H_5	98-104
I-110	H	H	4-OMe	H	i-Pr	C_2H_5	94-98
I-111	H	H	4-Me	H	i-Pr	C_2H_5	79-85
I-112	6-Cℓ	H	2-Cℓ	H	i-Pr	C_2H_5	oil
I-113	H	H	4-CF_3	H	i-Pr	C_2H_5	117-128
I-114	H	H	3-Me	4-F	i-Pr	C_2H_5	85-92
I-115	H	H	3-Me	5-Me	i-Pr	C_2H_5	oil
I-116	6-OMe	7-OMe	4-F	H	i-Pr	C_2H_5	gum
I-117	H	H	4-F	H	C_2H_5	C_2H_5	oil
I-118	H	H	4-F	H	n-Pr	C_2H_5	oil
I-119	6-Cℓ	H	4-F	H	i-Pr	C_2H_5	79-82
I-120	H	H	4-F	H	c-Pr	C_2H_5	100-104
I-121	H	H	4-OPh	H	i-Pr	C_2H_5	oil
I-122	6-Cℓ	8-Cℓ	4-F	H	i-Pr	C_2H_5	133-143
I-123	6-Cℓ	H	H	H	Ph	C_2H_5	gum
I-124	6-Cℓ	H	H	H	c-Pr	C_2H_5	oil
I-125	H	H	4-F	H	sec-Bu	C_2H_5	oil

I-126	6-Me	H	4-F	H	i-Pr	C_2H_5	oil
I-127	6-OMe	7-OMe	4-F	H	c-Pr	C_2H_5	gum

I-17

H-NMR (in $CDCl_3$) δ ppm :

1.29(t,3H,J=7Hz), 1.40(d,6H,J=6Hz)
1.4-1.7(m,2H), 2.3-2.5(m,2H)
2.9-3.2(m,1H), 3.49(Heptaplet,1H,J=6Hz)
3.5-3.8(m,1H), 3.9-4.5(m,2H)
4.20(q,2H,J=7Hz), 5.2-5.7(m,1H)
6.5-6.9(m,1H), 7.0-8.2(m,8H)

I-18

H-NMR (in $CDCl_3$) δ ppm :

1.0-1.4(m,2H), 1.31(t,3H,J=7Hz)
1.39(d,6H,J=6Hz), 2.3-2.5(m,2H)
2.52(s,3H), 3.1-3.4(m,1H)
3.48(Heptaplet,1H,J=6Hz),3.5-3.8(m,1H)
3.8-4.1(m,1H), 4.20(q,2H,J=7Hz)
4.2-4.5(m,1H), 5.2-5.6(m,1H)
6.4-6.8(m,1H), 7.0-8.0(m,8H)

I - 19

H-NMR (in $CDCl_3$) δ ppm :

1.29(t,3H,J=7Hz), 1.38(d,6H,J=6Hz)

1.4-1.8(m,2H), 2.3-2.5(m,2H)

3.2-3.4(m,1H), 3.49 (Heptaplet,1H,J=6Hz)

3.6-3.8(m,1H), 3.9-4.2(m,1H)

4.20(q,2H,J=7Hz), 4.3-4.5(m,1H)

5.2-5.5(m,1H), 6.5-6.8(m,1H)

7.0-8.2(m,8H)

I - 110

H-NMR (in $CDCl_3$) δ ppm :

1.29(t,3H,J=7Hz), 1.40(d,6H,J=6Hz)

1.5-1.6(m,2H), 2.3-2.5(m,2H)

2.8-3.0(m,1H), 3.4-3.6(m,1H)

3.52(Heptaplet,1H,J=6Hz),3.88(s,3H)

3.9-4.1(m,1H), 4.20(q,2H,J=7Hz)

4.3-4.5(m,1H), 5.3-5.5(m,1H)

6.5-6.7(m,1H), 6.9-8.1(m,8H)

I - 111

H-NMR (in $CDCl_3$) δ ppm :

1.30(t,3H,J=7Hz), 1.3-1.5(m,2H)

1.39(d,6H,J=6Hz), 2.3-2.5(m,2H)

2.43(s,3H), 2.8-3.0(m,1H)

3.50(Heptaplet,1H,J=6Hz), 3.5-3.7(m,1H)

3.9-4.2(m,1H), 4.19(q,2H,J=7Hz)

4.2-4.5(m,1H), 5.2-5.6(m,1H)

6.4-6.8(m,1H), 6.9-8.2(m,8H)

I-112

^{1}H-NMR (in $CDCl_3$) δ ppm :

1.30(t,3H,J=7Hz), 1.3-1.6(m,2H)

1.37(d,6H,J=6Hz), 2.3-2.5(m,2H)

2.9-3.2(m,1H), 3.47 (Heptaplet,1H,J=6Hz)

3.5-3.8(m,1H), 3.9-4.1(m,1H)

4.19(q,2H,J=7Hz), 4.2-4.5(m,1H)

5.3-5.7(m,1H), 6.5-6.8(m,1H)

7.1-8.1(m,7H)

I-113

^{1}H-NMR(in $CDCl_3$) δ ppm :

1.0-1.3(m,2H), 1.30(t,3H,J=7Hz)

1.40(d,6H,J=6Hz), 2.3-2.4(m,2H)

3.3-3.5(m,1H), 3.49 (Heptaplet,1H,J=6Hz)

3.6-3.7(m,1H), 3.9-4.1(m,1H)

4.18(q,2H,J=7Hz), 4.2-4.5(m,1H)

5.1-5.5(m,1H), 6.5-6.8(m,1H)

7.2-8.2(m,8H)

I－114

H-NMR (in $CDCl_3$) δ ppm :

1.2-1.4(m,2H), 1.30(t,3H,J=7Hz)

1.39(d,6H,J=6Hz), 2.32(bs,3H)

2.3-2.5(m,2H), 3.0-3.3(m,1H)

3.50(Heptaplet,1H,J=6Hz), 3.6-3.8(m,1H)

3.8-4.1(m,1H), 4.20(q,2H,J=7Hz)

4.3-4.6(m,1H), 5.2-5.6(m,1H)

6.5-6.8(m,1H), 7.0-8.2(m,7H)

I－115

H-NMR (in $CDCl_3$) δ ppm :

1.1-1.4(m,2H), 1.30(t,3H,J=7Hz)

1.40(d,6H,J=6Hz), 2.2-2.5(m,2H)

2.35(s,6H), 2.7-3.1(m,1H)

3.51(Heptaplet,1H,J=6Hz), 3.6-3.7(m,1H)

3.8-4.1(m,1H), 4.20(q,2H,J=7Hz)

4.2-4.6(m,1H), 5.2-5.6(m,1H)

6.4-6.8(m,1H), 6.8-8.2(m,7H)

I－116

H-NMR (in $CDC\ell_3$) δ ppm :

1.30(t,3H,J=7Hz), 1.37(d,6H,J=6Hz)

1.5-1.8(m,2H), 2.3-2.5(m,2H)

2.9-3.2(m,1H), 3.46(Heptaplet,1H,J=6Hz)

3.6-3.8(m,1H), 3.75(s,3H)

3.9-4.1(m,1H), 4.07(s,3H)

4.20(q,2H,J=7Hz), 4.2-4.5(m,1H)

5.1-5.5(m,1H), 6.4-6.8(m,2H)

7.1-7.5(m,5H)

I－117

H-NMR(in $CDC\ell_3$) δ ppm :

1.30(t,3H,J=7Hz), 1.37(t,3H,J=7Hz)

1.4-1.7(m,2H), 2.2-2.6(m,2H)

2.8-3.2(m,3H), 3.6-3.9(m,1H)

3.9-4.7(m,4H), 5.2-5.7(m,1H)

6.3-6.7(m,1H) 7.0-8.2(m,8H)

I - 118

H-NMR (in $CDCl_3$) δ ppm :

1.01(t,3H,J=7Hz), 1.27(t,3H,J=7Hz)

1.4-2.1(m,4H), 2.3-2.6(m,2H)

2.8-3.3(m,3H), 3.6-3.8(m,1H)

3.9-4.1(m,1H), 4.18(q,2H,J=7Hz)

4.2-4.5(m,1H) 5.2-5.6(m,1H)

6.4-6.7(m,1H), 7.0-8.1(m,8H)

I - 119

H-NMR (in $CDCl_3$) δ ppm :

1.2-1.5(m,2H), 1.31(t,3H,J=7Hz)

1.37(d,6H,J=7Hz),2.3-2.6(m,2H)

3.0-3.4(m,1H), 3.49(Heptaplet,1H,J=6Hz)

3.6-3.8(m,1H), 3.8-4.2(m,1H)

4.20(q,2H,J=7Hz), 4.3-4.5(m,1H)

5.2-5.6(m,1H), 6.4-6.8(m,1H)

7.0-8.1(m,7H)

I - 120

H-NMR (in $CDCl_3$) δ ppm :

0.8-1.8(m,6H), 1.30(t,3H,J=7Hz)

2.1-2.6(m,3H), 2.9-3.3(m,1H)

3.4-3.7(m,1H), 3.8-4.6(m,2H)

4.20(q,2H,J=7Hz), 5.4-5.8(m,1H)

6.4-6.8(m,1H), 6.8-8.0(m,8H)

I − 1 2 1

H-NMR(in $CDCl_3$) δ ppm :

1.29(t,3H,J=7Hz), 1.39(d,6H,J=6Hz)

1.4-1.9(m,2H), 2.3-2.5(m,2H)

2.7-3.2(m,1H), 3.51(Heptaplet,1H,J=6Hz)

3.6-3.8(m,1H), 3.9-4.2(m,1H)

4.19(q,2H,J=7Hz), 4.3-4.6(m,1H)

5.2-5.6(m,1H), 6.4-6.8(m,1H)

6.9-8.2(m,13H)

I − 1 2 2

H-NMR (in $CDCl_3$) δ ppm :

1.1-1.8(m,2H), 1.31(t,3H,J=7Hz)

1.41(d,6H,J=6Hz), 2.3-2.5(m,2H)

2.9-3.4(m,1H), 3.50(Heptaplet,1H,J=6Hz)

3.6-3.8(m,1H), 3.9-4.5(m,2H)

4.20(q,2H,J=7Hz), 5.2-5.6(m,1H)

6.4-6.8(m,1H), 7.1-7.3(m,5H)

7.72(d,1H,J=6Hz)

I－123

H-NMR (in $CDCl_3$) δ ppm :

0.8-1.5(m,2H), 1.29(t,3H,J=7Hz)

2.2-2.4(m,2H), 2.6-2.9(m,1H)

3.2-3.6(m,1H), 3.7-4.3(m,2H)

4.17(q,2H,J=7Hz), 5.0-5.4(m,1H)

6.1-6.5(m,1H), 7.0-8.2(m,13H)

I－124

H-NMR (in $CDCl_3$) δ ppm :

0.8-1.8(m,6H), 1.29(t,3H,J=7Hz),

2.2-2.6(m,3H), 2.8-3.2(m,1H),

3.3-3.7(m,1H), 3.9-4.5(m,2H),

4.19(q,2H,J=7Hz), 5.4-5.8(m,1H),

6.5-6.8(m,1H), 7.1-8.0(m,8H),

I－125

H-NMR (in $CDCl_3$) δ ppm :

0.94(d,6H,J=6Hz), 1.0-1.7(m,3H),

1.27(t,3H,J=7Hz), 1.9-2.5(m,3H),

2.90(d,2H,J=7Hz), 3.3-4.4(m,3H),

4.12(q,2H,J=7Hz), 5.0-5.5(m,1H),
6.2-6.7(m,1H), 6.9-8.0(m,8H),

I − 1 2 6

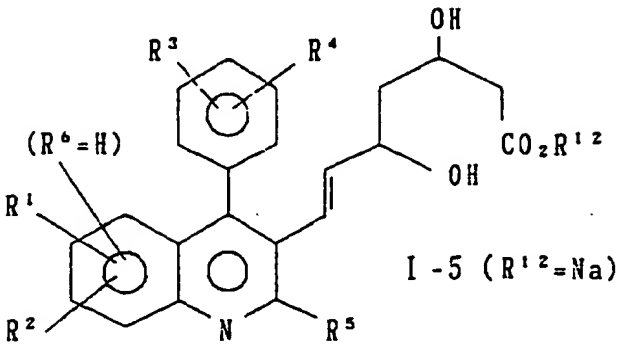
H-NMR (in $CDCl_3$) δ ppm :
1.0-1.6(m,3H), 1.21(t,3H,J=7Hz),
1.34(d,6H,J=6Hz), 2.34(s,3H),
2.37(d,2H,J=7Hz), 2.9-3.7(m,2H),
3.8-4.5(m,2H), 4.15(q,2H,J=7Hz),
5.0-5.5(m,1H), 6.3-6.7(m,1H),
6.9-8.0(m,7H),

I − 1 2 7

H-NMR (in $CDCl_3$) δ ppm :
0.8-1.9(m,8H), 1.29(t,3H,J=7Hz),
2.1-2.6(m,3H), 2.8-3.2(m,1H),
3.72(s,3H), 4.02(s,3H),
4.19(q,2H,J=7Hz), 4.3-4.6(m,1H),
5.4-5.8(m,1H), 6.4-6.8(m,1H),
6.56(s,1H), 7.0-7.4(m,5H)

In th same manner as in Exmple 2, compounds I-52 to I-527 were prepared.

Table 11



I-5 (R^{12}=Na)

Compound	R^1	R^2	R^3	R^4	R^5	R^{12}	m. p. (℃)
I-52	H	H	4-F	H	CH_3	Na	138-142 (decomposed)
I-53	H	H	H	H	CH_3	Na	130-132 (decomposed)
I-54	H	H	H	H	i-Pr	Na	196-197 (decomposed)
I-55	6-Cℓ	H	H	H	CH_3	Na	211-215 (decomposed)
I-56	6-Cℓ	H	H	H	i-Pr	Na	195-198 (decomposed)
I-57	H	H	2-F	H	i-Pr	Na	193-201 (decomposed)
I-58	7-Me	H	H	H	i-Pr	Na	170-175 (decomposed)
I-59	H	H	4-Cℓ	H	i-Pr	Na	193-202 (decomposed)
I-510	H	H	4-OMe	H	i-Pr	Na	178-193 (decomposed)
I-511	H	H	4-Me	H	i-Pr	Na	187-200 (decomposed)

I-512	6-Cℓ	H	2-Cℓ	H	i-Pr	Na	203-209 (decomposed)
I-513	H	H	4-CF_3	H	i-Pr	Na	200-212 (decomposed)
I-514	H	H	3-Me	4-F	i-Pr	Na	195-200 (decomposed)
I-515	H	H	3-Me	5-Me	i-Pr	Na	192-197 (decomposed)
I-516	6-OMe	7-OMe	4-F	H	i-Pr	Na	239-245 (decomposed)
I-517	H	H	4-F	H	C_2H_5	Na	230-237 (decomposed)
I-518	H	H	4-F	H	n-Pr	Na	193-200 (decomposed)
I-519	6-Cℓ	H	4-F	H	i-Pr	Na	193-198 (decomposed)
I-520	H	H	4-F	H	c-Pr	Na	197-199 (decomposed)
I-521	H	H	4-OPh	H	i-Pr	Na	180-189 (decomposed)
I-522	6-Cℓ	8-Cℓ	4-F	H	i-Pr	Na	183-187 (decomposed)
I-523	6-Cℓ	H	H	H	Ph	Na	190-196 (decomposed)
I-524	6-Cℓ	H	H	H	c-Pr	Na	204-210 (decomposed)
I-525	H	H	4-F	H	sec-Bu	Na	---
I-526	6-Me	H	4-F	H	i-Pr	Na	204-208 (decomposed)
I-527	6-OMe	7-OMe	4-F	H	c-Pr	Na	234-238 (decomposed)

I-57

H-NMR (in DMSO-d^6) δ ppm :

0.9-1.2(m,2H), 1.37(d,6H,J=7Hz)

1.6-2.1(m,2H), 3.48(Heptaplet,1H,J=6Hz)

3.7-4.3(m,4H), 5.3-5.6(m,1H)

6.4-6.7(m,1H), 7.1-8.1(m,8H)

I-58

H-NMR(in DMSO-d^6) δ ppm :

0.9-1.2(m,2H), 1.31(d,6H,J=7Hz)

1.7-2.2(m,2H), 2.50(s,3H)

3.3-4.5(m,5H), 5.2-5.6(m,1H)

6.3-6.6(m,1H), 7.1-7.9(m,8H)

I-59

H-NMR(in DMSO-d^6) δ ppm :

0.9-1.3(m,2H), 1.33(d,6H,J=7Hz)

1.6-2.2(m,2H), 3.48(Heptaplet,1H,J=7Hz)

3.5-4.6(m,4H), 5.2-5.6(m,2H)

6.3-6.6(m,1H), 7.1-8.1(m,8H)

I-510

H-NMR(in DMSO-d^6) δ ppm :

1.0-1.3(m,2H), 1.32(d,6H,J=7Hz)

1.6-2.2(m,2H), 3.0-3.8(m,4H)

3.86(s,3H), 4.0-4.3(m,1H)

5.3-5.6(m,1H), 6.3-6.6(m,1H)

6.9-8.1(m,8H)

I－5 1 1

H-NMR (in DMSO-d^6) δ ppm :

0.9-1.3(m,2H), 1.33(d,6H,J=7Hz)

1.7-2.1(m,2H), 2.41(s,3H)

3.2-4.3(m,5H), 5.3-5.6(m,1H)

6.3-6.6(m,1H), 7.0-8.3(m,8H)

I－5 1 2

H-NMR (in DMSO-d^6) δ ppm :

0.9-1.3(m,2H), 1.33(d,6H,J=7Hz)

1.6-2.2(m,2H), 3.1-3.8(m,3H)

3.48(Heptaplet,1H,J=7Hz),3.9-4.2(m,1H)

5.3-5.7(m,1H), 6.3-6.7(m,1H)

7.0-8.1(m,7H)

I－5 1 3

H-NMR (in DMSO-d^6) δ ppm :

0.8-1.3(m,2H), 1.34(d,6H,J=7Hz)

1.6-2.2(m,2H), 2.7-3.9(m,3H)

3.49(Heptaplet,1H,J=7Hz),3.9-4.3(m,1H)

5.2-5.6(m,1H), 6.3-6.7(m,1H)

7.1-8.1(m,8H)

I-514

H-NMR (in DMSO-d^6) δ ppm :

0.9-1.3(m,2H), 1.35(d,6H,J=7Hz)

1.7-2.1(m,2H), 2.30(d,3H,J=2Hz)

3.0-3.8(m,3H), 3.51(Heptaplet,1H,J=7Hz)

3.9-4.3(m,1H), 5.3-5.6(m,1H)

6.3-6.6(m,1H), 6.9-8.1(m,7H)

II-515

H-NMR (in DMSO-d^6) δ ppm :

1.0-1.2(m,2H), 1.35(d,6H,J=7Hz)

1.6-2.2(m,2H), 2.35(s,6H)

3.0-3.8(m,3H), 3.51(Heptaplet,1H,J=7Hz)

4.0-4.3(m,1H), 5.3-5.6(m,1H)

6.3-6.6(m,1H), 6.8-8.0(m,7H)

I-516

H-NMR (in DMSO-d^6) δ ppm :

0.9-1.3(m,2H), 1.31(d,6H,J=7Hz)

1.7-2.0(m,2H), 3.2-3.7(m,4H)

3.62(s,3H), 3.9-4.2(m,1H)

3.94(s,3H), 5.1-5.5(m,1H)

6.2-6.6(m,1H), 7.0-7.5(m,6H)

I-517

H-NMR (in DMSO-d^6) δ ppm :

0.9-1.5(m,2H), 1.34(t,3H,J=7Hz)

1.6-2.2(m,2H), 2.7-3.4(m,4H)

3.6-4.3(m,2H), 5.2-5.7(m,1H)

6.1-6.6(m,1H), 6.9-8.1(m,8H)

I-518

H-NMR (in DMSO-d^6) δ ppm :

0.8-1.3(m,2H), 1.01(t,3H,J=7Hz)

1.6-2.1(m,4H), 2.7-3.8(m,5H)

3.9-4.3(m,1H), 5.2-5.7(m,1H)

6.3-6.6(m,1H), 7.1-8.1(m,8H)

I-519

H-NMR (in DMSO-d^6) δ ppm :

0.9-1.3(m,2H), 1.33(d,6H,J=7Hz)

1.6-2.2(m,2H), 2.9-3.9(m,3H)

3.49(Heptaplet,1H,J=7Hz),4.0-4.3(m,1H)

5.3-5.6(m,1H), 6.3-6.6(m,1H)

7.2-8.1(m,7H)

I-520

H-NMR (in DMSO-d^6) δ ppm :

0.8-1.5(m,6H), 1.7-2.2(m,2H)

2.3-2.7(m,1H), 3.0-3.9(m,3H)

4.0-4.3(m,1H), 5.5-5.8(m,1H)

6.4-6.7(m,1H), 7.2-8.0(m,8H)

I-521

H-NMR (in DMSO-d^6) δ ppm :

0.9-1.5(m,2H), 1.36(d,6H,J=7Hz)

1.7-2.3(m,2H), 3.0-3.9(m,3H)

3.50(Heptaplet,1H,J=6Hz),4.0-4.3(m,1H)

5.2-5.6(m,1H) 6.4-6.7(m,1H)

7.0-8.1(m,13H)

I-522

H-NMR (in DMSO-d^6) δ ppm :

0.8-1.3(m,2H), 1.37(d,6H,J=7Hz)

1.6-2.2(m,2H), 3.1-3.9(m,3H)

3.51(Heptaplet,1H,J=7Hz),4.0-4.3(m,1H)

5.3-5.7(m,1H), 6.3-6.7(m,1H)

7.1-8.0(m,6H)

I-523

H-NMR (in DMSO-d^6) δ ppm :

0.8-1.4(m,2H), 1.6-2.1(m,2H)

2.9-3.7(m,3H), 3.7-4.1(m,1H)

5.1-5.4(m,1H), 6.1-6.4(m,1H)

7.1-8.2(m,13H).

I-524

H-NMR (in DMSO-d^6) δ ppm :

0.8-1.5(m,5H), 1.6-2.2(m,2H)

2.3-2.7(m,2H), 3.0-3.8(m,3H)

3.9-4.3(m,1H), 5.4-5.8(m,1H)

6.3-6.6(m,1H), 7.0-8.0(m,8H)

I-525

H-NMR (in DMSO-d^6) δ ppm :

0.9-1.6(m,2H), 0.96(d,6H,J=6Hz)

1.7-2.6(m,3H), 2.89(d,2H,J=7Hz)

3.0-3.8(m,3H), 3.9-4.2(m,1H)

5.2-5.6(m,1H), 6.2-6.6(m,1H)

7.1-8.1(m,8H)

I－526

H-NMR (in DMSO-d^6) δ ppm :

1.30(d,6H,J=7Hz), 1.7-2.0(m,2H),
2.34(s,3H), 2.4-2.6(m,1H),
3.0-3.3(m,2H), 3.3-3.8(m,3H)
3.9-4.2(m,1H), 5.2-5.6(m,1H)
6.3-6.6(m,1H), 7.0-8.0(m,7H)

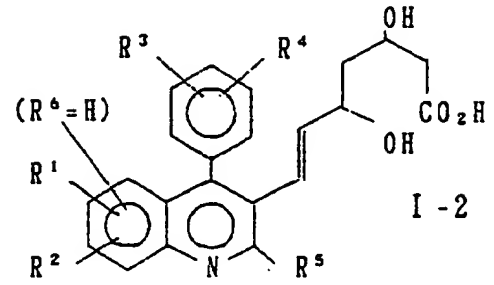
I－527

H-NMR (in DMSO-d^6) δ ppm :

0.7-1.5(m,5H), 1.8-2.2(m,2H),
2.2-2.6(m,2H), 3.1-3.3(m,2H),
3.59(s,3H), 3.9-4.2(m,2H),
3.91(s,3H), 5.4-5.7(m,1H)
6.3-6.6(m,1H), 6.52(s,1H),
7.0-7.4(m,5H)

In the same manner as in Example 3, compounds I-22 to I-26 can be prepared.

Table 12

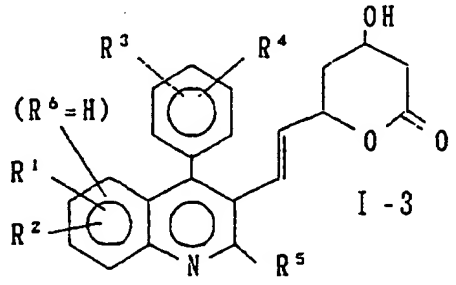


I-2

Compound	R^1	R^2	R^3	R^4	R^5
I-22	H	H	4-F	H	CH_3
I-23	H	H	H	H	CH_3
I-24	H	H	H	H	i-Pr
I-25	6-Cℓ	H	H	H	CH_3
I-26	6-Cℓ	H	H	H	i-Pr

In the same manner as in Example 4, compounds I-32 to I-36 can be prepared.

Table 13



I-3

Compound	R^1	R^2	R^3	R^4	R^5
I-32	H	H	4-F	H	CH_3
I-33	H	H	H	H	CH_3
I-34	H	H	H	H	i-Pr
I-35	6-Cℓ	H	H	H	CH_3
I-36	6-Cℓ	H	H	H	i-Pr

FORMULATION EXAMPLE 1

Tablets	
Compound I-51	1.0 g
Lactose	5.0 g
Crystal cellulose powder	8.0 g
Corn starch	3.0 g
Hydroxypropyl cellulose	1.0 g
CMC-Ca	1.5 g
Magnesium stearate	0.5 g
Total	20.0 g

The above components were mixed by a usual method and then tabletted to produce 100 tablets each containing 10 mg of the active ingredient.

FORMULATION EXAMPLE 2

Capsules	
Compound I-51	1.0 g
Lactose	3.5 g
Crystal cellulose powder	10.0 g
Magnesium stearate	0.5
Total	15.0 g

The above components were mixed by a usual method and then packed in No. 4 gelatin capsules to obtain 100 capsules each containing 10 mg of the active ingredient.

FORMULATION EXAMPLE 3

Soft capsules	
Compound I-51	1.00 g
PEG (polyethylene glycol) 400	3.89 g
Saturated fatty acid triglyceride	15.00 g
Peppermint oil	0.01 g
Polysorbate 80	0.10 g
Total	20.00 g

The above components were mixed and packed in No. 3 soft gelatin capsules by a usual method to obtain 100 soft capsules each containing 10 mg of the active ingredient.

FORMULATION EXAMPLE 4

Ointment	
Compound I-51	1.0 g (10.0 g)
Liquid paraffin	10.0 g (10.0 g)
Cetanol	20.0 g (20.0 g)
White vaseline	68.4 g (59.4 g)
Ethylparaben	0.1 g (0.1 g)
L-menthol	0.5 g (0.5 g)
Total	100.0 g

The above components were mixed by a usual method to obtain a 1% (10%) ointment.

FORMULATION EXAMPLE 5

Suppository	
Compound I-51	1.0 g
Witepsol H15*	46.9 g
Witepsol W35*	52.0 g
Polysorbate 80	0.1 g
Total	100.0 g

*: Trademark for triglyceride compound

The above components were melt-mixed by a usual method and poured into suppository containers, followed by cooling for solidification to obtain 100 suppositories of 1 g each containing 10 mg of the active component.

FORMULATION EXAMPLE 6

Injection formulation	
Compound I-51	1 mg
Distilled water for injection formulation	5 ml

The formulation is prepared by dissolving the compound in the distilled water whenever it is required.

FORMULATION EXAMPLE 7

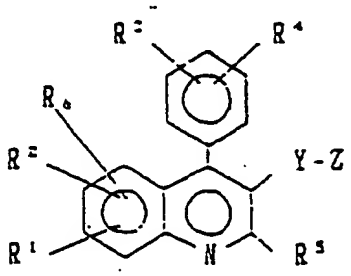
Granules	
Compound I-51	1.0 g
Lactose	6.0 g
Crystal cellulose powder	6.5 g
Corn starch	5.0 g
Hydroxypropyl cellulose	1.0 g
Magnesium stearate	0.5 g
Total	20.0 g

Th above components wer granulated by a usual method and packaged to obtain 100 packages ach containing 200 mg of the granules so that each packag contains 10 mg of the active ingredient.

Claims

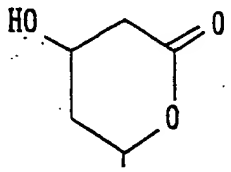
Claims for the following Contracting States : CH, LI, AT, BE, DE, FR, GB, IT, NL, SE, LU

1. A compound of the formula:



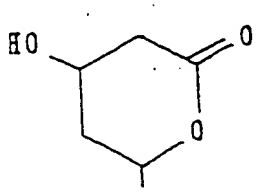
(I)

wherein R^1 is hydrogen, C_{1-4} alkyl, C_{1-3} alkoxy, n-butoxy, i-butoxy, sec-butoxy, R^7R^8N-(wherein R^7 and R^8 are C_{1-3} alkyl), fluoro, chloro, bromo or benzyloxy;
R^2 is hydrogen, C_{1-4} alkyl, C_{1-3} alkoxy, n-butoxy, i-butoxy, sec-butoxy, fluoro, chloro or bromo;
or when located at the ortho position to each other, R^1 and R^2 together form -CH=CH-CH=CH-;
R^3 is hydrogen, C_{1-4} alkyl, C_{1-3} alkoxy, n-butoxy, i-butoxy, sec-butoxy, fluoro, chloro, bromo, trifluoromethyl, phenoxy, phenyl or benzyloxy;
R^4 is hydrogen, C_{1-4} alkyl, fluoro, chloro or bromo;
R^5 is C_{1-6} alkyl, C_{3-6} cycloalkyl or phenyl;
R^6 is hydrogen;
Y is $-CH_2-$, CH_2CH_2-, -CH=CH-, $-CH_2-CH=CH-$ or $-CH=CH-CH_2$; and Z is



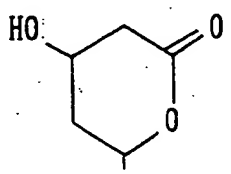
or $-Q-CH_2-W-CH_2-CO_2R^{12}$
(wherein Q is -C(O)- or -CH(OH)-; W is -C(O)- or -CH(OH)-; and R^{12} is hydrogen, physiologically hydrolyzable alkyl, NH_4, sodium, potassium or 1/2 calcium).

2. The compound according to Claim 1, wherein in the formula I, R^1 is hydrogen, fluoro, chloro, bromo, C_{1-4} alkyl or C_{1-3} alkoxy;
R^2 is hydrogen, C_{1-3} alkoxy, fluoro, chloro or bromo;
R^3 is hydrogen, C_{1-4} alkyl, C_{1-3} alkoxy, fluoro, chloro or bromo;
R^4 is hydrogen, fluoro, chloro or bromo;
R^5 is C_{1-6} alkyl or C_{3-6} cycloalkyl;
Y is $-CH_2-CH_2-$ or -CH=CH-; and
Z is



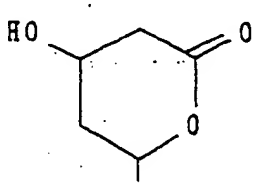
$-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ or $-CH(OH)CH_2C(O)CH_2CO_2R^{12}$ (wherein R^{12} is hydrog n, physiologically hydrolyzable alkyl, NH_4, sodium, potassum or 1/2 calcium).

3. The compound according to Claim 1, wher in R^1 is hydrogen, methyl, ethyl, n-propyl, i-propyl, methoxy, ethoxy, fluoro, chloro or bromo;
R^2 is hydrogen, methoxy, ethoxy, fluoro, chloro or bromo;
R^3 is hydrogen, methyl, methoxy, ethoxy, fluoro, chloro or bromo;
R^4 is hydrogen, fluoro or chloro;
R^5 is methyl, ethyl, n-propyl, i-propyl or C_{3-6} cycloalkyl;
Y is $-CH_2CH_2-$ or -CH=CH-; and
Z is



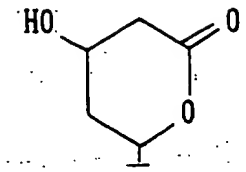
or $-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ (wherein R^{12} is hydrogen, physiologically hydrolyzable alkyl, NH_4, sodium, potassium or 1/2 calcium).

4. The compound according to Claim 1, wherein R^1 is hydrogen, methyl, ethyl, methoxy, ethoxy, fluoro or chloro;
R^2 is hydrogen, methoxy, ethoxy, fluoro or chloro;
R^3 is hydrogen, methoxy, ethoxy, fluoro or chloro;
R^4 is hydrogen, fluoro or chloro;
R^5 is methyl, ethyl, n-propyl, i-propyl or C_{3-6} cycloalkyl;
Y is -CH=CH-; and
Z is



or
$-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ (wherein R^{12} is hydrogen, physiologically hydrolyzable alkyl, NH_4, sodium, potassium or 1/2 calcium).

5. The compound according to Claim 1, wherein R^1 is hydrogen, methyl, methoxy or chloro;
R^2 is hydrogen or methoxy;
R^3 is hydrogen, fluoro or chloro;
R^4 is hydrogen;
R^5 is i-propyl or cyclopropyl;
Y is -CH=CH-; and
Z is



or

-CH(OH)CH_2CH(OH)$CH_2CO_2R^{12}$ (wherein R^{12} is hydrogen, physiologically hydrolyzable alkyl, NH_4, sodium, potassium or 1/2 calcium).

6. The compound according to Claim 1, which is (E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-cyclopropyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-cyclopropyl-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-cyclopropyl-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-cyclopropyl-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-(1"-methylethyl)-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-(1"-methylethyl)-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-(1"-methylethyl)-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-(1"-methylethyl)-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-cyclopropyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy 7-[4'-(4"-chlorophenyl)-2'-cyclopropyl-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-cyclopropyl-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-cyclopropyl-6'7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid,

a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by th condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-cyclopropyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid ;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid ;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-6'-methoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid; or
(E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-cyclopropyl-6'-methoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid.

7. An anti-hyperlipidemia agent containing the compound of the formula I as defined in Claim 1.

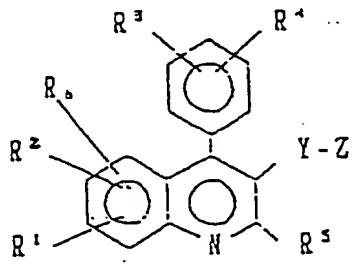
8. An anti-hyperlipoproteinemia agent containing the compound of the formula I as defined in Claim 1.

9. An anti-atherosclerosis agent containing the compound of the formula I as defined in Claim 1.

10. Use of a compound according to claim 1 in manufacture of a therapeutic agent for reducing hyperlipidemia, hyperlipoproteinemia or atherosclerosis.

Claims for the following Contracting States : ES, GR

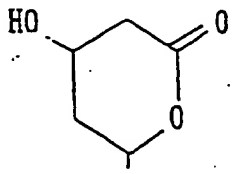
1. A process for preparing a compound of the formula:



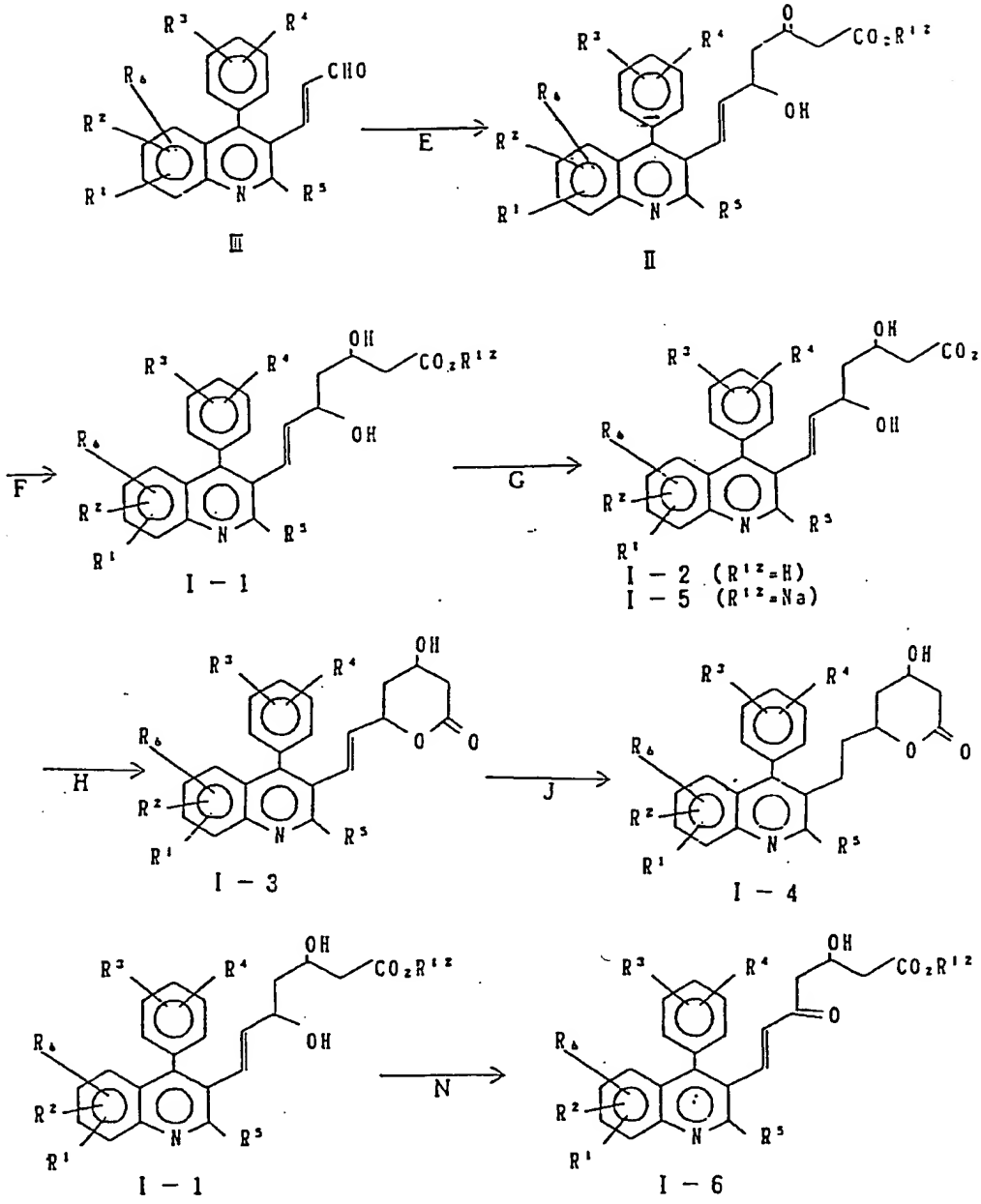
(I)

wherein R^1 is hydrogen, C_{1-4} alkyl, C_{1-3} alkoxy, n-butoxy, i-butoxy, sec-butoxy, R^7R^8N-(wherein R^7

and R^8 are C_{1-3} alkyl), fluoro, chloro, bromo or benzyloxy;
R^2 is hydrogen, C_{1-4} alkyl, C_{1-3} alkoxy, n-butoxy, i-butoxy, sec-butoxy, fluoro, chloro or bromo;
or when located at the ortho position to each other, R^1 and R^2 together form -CH=CH-CH=CH-;
R^3 is hydrogen, C_{1-4} alkyl, C_{1-3} alkoxy, n-butoxy, i-butoxy, s c-butoxy, fluoro, chloro, bromo, trifluoromethyl, phenoxy, phenyl or benzyloxy;
R^4 is hydrogen, C_{1-4} alkyl, fluoro, chloro or bromo;
R^5 is C_{1-6} alkyl, C_{3-6} cycloalkyl or phenyl;
R^6 is hydrogen;
Y is $-CH_2-$, CH_2CH_2-, -CH=CH-, $-CH_2-CH=CH-$ or $-CH=CH-CH_2$; and
Z is



or $-Q-CH_2-W-CH_2-CO_2R^{12}$
(wherein Q is -C(O)- or -CH(OH)-; W is -C(O)- or -CH(OH)-; and R^{12} is hydrogen, physiologically hydrolyzable alkyl, NH_4, sodium, potassium or 1/2 calcium), characterized in that the compounds of formula (I) are prepared by the following reaction scheme:



wherein R^1, R^2, R^3, R^4, R^5, R^6 and R^{12} are as defined above with respect to formula I, and R^{21} and R^{22} independently represent C_{1-4} alkyl; wherein

step E represents a double anion condensation reaction between the enal III and an acetoacetate by using sodium hydride and n-butyl lithium in tetrahydrofuran at a temperature of -80 to 0 °C;

step F represents a reduction reaction of the carbonyl group by using a metal hydride in ethanol at a temperature of from -10 to 25 °C or by using zinc borohydride in dry ethyl ether or dry tetrahydrofuran at a temperature of -100 to 25 °C;

step G is a step for hydrolyzing the ester by using an equimolar anount of a base in a solvent mixture of water and methanol or ethanol at a temperature of from 10 to 25 °C;

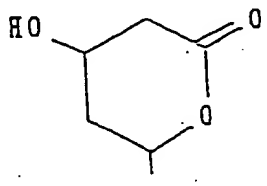
step H is a step for forming a mevalonolactone by the dehydration reaction of the free hydroxy acid I-2;

step J represents a reaction for hydrogenating the double bond connecting the mevalonolactone moiety and the quinoline ring by using a catalytic amount of palladium-carbon of rhodium-carbon in a

solvent at a temperature of from 0 to 50 °C; and

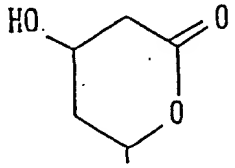
step N r presents a reaction for the synthesis of an α,β-unsaturated ketone by the selective oxidation of the dihydroxy carboxylic acid ester by using activated manganese dioxide in a solvent at a temperature of from 20 to 80 °C.

2. A process according to Claim 1, wherein in the formula I, R^1 is hydrogen, fluoro, chloro, bromo, C_{1-4} alkyl or C_{1-3} alkoxy;
R^2 is hydrogen, C_{1-3} alkoxy, fluoro, chloro or bromo;
R^3 is hydrogen, C_{1-4} alkyl, C_{1-3} alkoxy, fluoro, chloro or bromo;
R^4 is hydrogen, fluoro, chloro or bromo;
R^5 is C_{1-6} alkyl or C_{3-6} cycloalkyl;
Y is $-CH_2-CH_2-$ or $-CH=CH-$; and
Z is



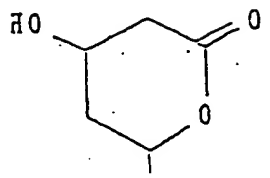
$-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ or $-CH(OH)CH_2C(O)CH_2CO_2R^{12}$ (wherein R^{12} is hydrogen, physiologically hydrolyzable alkyl, NH_4, sodium, potassium or 1/2 calcium).

3. A process according to Claim 1, wherein R^1 is hydrogen, methyl, ethyl, n-propyl, i-propyl, methoxy, ethoxy, fluoro, chloro or bromo;
R^2 is hydrogen, methoxy, ethoxy, fluoro, chloro or bromo;
R^3 is hydrogen, methyl, methoxy, ethoxy, fluoro, chloro or bromo;
R^4 is hydrogen, fluoro or chloro;
R^5 is methyl, ethyl, n-propyl, i-propyl or C_{3-6} cycloalkyl;
Y is $-CH_2CH_2-$ or $-CH=CH-$; and
Z is



or $-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ (wherein R^{12} is hydrogen, physiologically hydrolyzable alkyl, NH_4, sodium, potassium or 1/2 calcium).

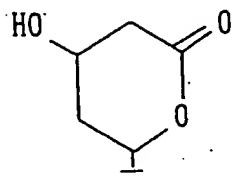
4. A process according to Claim 1, wherein R^1 is hydrogen, methyl, ethyl, methoxy, ethoxy, fluoro or chloro;
R^2 is hydrogen, methoxy, ethoxy fluoro or chloro;
R^3 is hydrogen, methoxy, ethoxy, fluoro or chloro;
R^4 is hydrogen, fluoro or chloro;
R^5 is methyl, ethyl, n-propyl, i-propyl or C_{3-6} cycloalkyl;
Y is $-CH=CH-$; and
Z is



or

-CH(OH)CH_2CH(OH)$CH_2CO_2R^{12}$ (wherein R^{12} is hydrogen, physiologically hydrolyzable alkyl, NH_4, sodium, potassium or 1/2 calcium).

5. A process according to Claim 1, wherein R^1 is hydrogen, methyl, methoxy or chloro;
R^2 is hydrogen or methoxy;
R^3 is hydrogen, fluoro or chloro;
R^4 is hydrogen;
R^5 is i-propyl or cyclopropyl;
Y is -CH = CH-; and
Z is



or

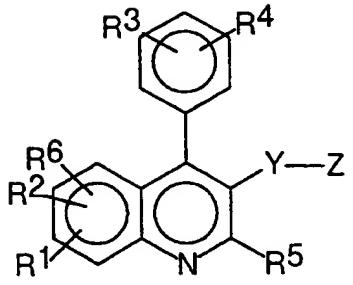
-CH(OH)CH_2CH(OH)$CH_2CO_2R^{12}$ (wherein R^{12} is hydrogen, physiologically hydrolyzable alkyl, NH_4, sodium, potassium or 1/2 calcium).

6. A process according to Claim 1, which produces (E)-3,5-dihydroxy-7-[4'-(4''-fluorophenyl)-2'-(1''-methylethyl)-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4''-fluorophenyl)-2'-(1''-methylethyl)-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4''-fluorophenyl)-2'-(1''-methylethyl)-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4''-fluorophenyl)-2'-(1''-methylethyl)-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4''-fluorophenyl)-2'-cyclopropyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4''-fluorophenyl)-2'-cyclopropyl-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4''-fluorophenyl)-2'-cyclopropyl-6'-methyl-quinolin-3'-yl]-hept-6--enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4''-fluorophenyl)-2'-cyclopropyl-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of th carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4''-chlorophenyl)-2'-(1''-methylethyl)-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or

C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-(1"-methylethyl)-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-(1"-methylethyl)-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-(1"-methylethyl)-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-cyclopropyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-cyclopropyl-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-chlorophenyl)-2'-cyclopropyl-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-[4"-chlorophenyl)-2'-cyclopropyl-6'7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-6'-chloro-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-cyclopropyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6'-chloro-quinolin-3'-yl)-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6'-methyl-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6',7'-dimethoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid;
(E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-(1"-methylethyl)-6'-methoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid; or
(E)-3,5-dihydroxy-7-[4'-(4"-fluorophenyl)-2'-cyclopropyl-6'-methoxy-quinolin-3'-yl]-hept-6-enoic acid, a lactone formed by the condensation of the carboxylic acid with hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl hydroxy at the 5-position, or a sodium salt or C_{1-3} alkyl ester of the carboxylic acid.

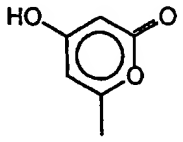
Patentanspruch
Patentanspruch für folgend Vertragsstaaten : CH, LI, AT, BE, DE, FR, GB, IT, NL, SE, LU

1. Verbindung der Formel:



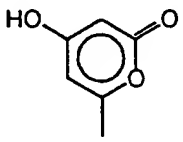
(I)

worin R^1 Wasserstoff, C_{1-4}-Alkyl, C_{1-3}-Alkoxy, n-Butoxy, i-Butoxy, sec-Butoxy, R^7R^8N- (worin R^7 und R^8 C_{1-3}-Alkyl sind), Fluor, Chlor, Brom oder Benzyloxy ist;
R^2 Wasserstoff, C_{1-4}-Alkyl, C_{1-3}-Alkoxy, n-Butoxy, i-Butoxy, sec-Butoxy, Fluor, Chlor oder Brom ist; oder
wenn sie in der o-Position zueinander angeordnet sind, R^1 und R^2 zusammen -CH=CH-CH=CH- bilden;
R^3 Wasserstoff, C_{1-4}-Alkyl, C_{1-3}-Alkoxy, n-Butoxy, i-Butoxy, sec-Butoxy, Fluor, Chlor, Brom, Trifluormethyl, Phenoxy, Phenyl oder Benzyloxy ist;
R^4 Wasserstoff, C_{1-4}-Alkyl, Fluor, Chlor oder Brom ist;
R^5 C_{1-6}-Alkyl, C_{1-3}-Cycloalkyl oder Phenyl ist;
R^6 Wasserstoff ist;
Y $-CH_2-$, $-CH_2CH_2-$, $-CH=CH-$, $-CH_2CH=CH-$ oder $-CH=CH-CH_2-$ ist und
Z



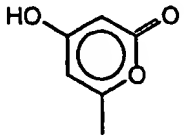
oder $-Q-CH_2-W-CH_2-CO_2R^{12}$ ist (worin Q -C(O)- oder -CH(OH)- ist; W -C(O)- oder -CH(OH)- ist und R^{12} Wasserstoff, physiologisch hydrolysierbares Alkyl, NH_4, Natrium, Kalium oder 1/2 Calcium ist).

2. Verbindung nach Anspruch 1, worin in Formel I R^1 Wasserstoff, Fluor, Chlor, Brom, C_{1-4}-Alkyl oder C_{1-3}-Alkoxy ist;
R^2 Wasserstoff, C_{1-3}-Alkoxy, Fluor, Chlor oder Brom ist;
R^3 Wasserstoff, C_{1-4}-Alkyl, C_{1-3}-Alkoxy, Fluor, Chlor oder Brom ist;
R^4 Wasserstoff, Fluor, Chlor oder Brom ist;
R^5 C_{1-6}-Alkyl oder C_{1-3}-Cycloalkyl ist;
Y $-CH_2-CH_2-$ oder $-CH=CH-$ ist und
Z



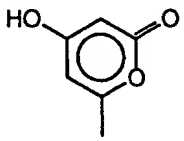
$-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ oder $-CH(OH)CH_2C(O)CH_2CO_2R^{12}$ ist (worin R^{12} Wasserstoff, physiologisch hydrolysierbares Alkyl, NH_4, Natrium, Kalium oder 1/2 Calcium ist).

3. Verbindung nach Anspruch 1, worin R^1 Wasserstoff, Methyl, Ethyl, n-Propyl, i-Propyl, M thoxy, Ethoxy, Fluor, Chlor oder Brom ist;
R^2 Wasserstoff, Methoxy, Ethoxy, Fluor, Chlor oder Brom ist;
R^3 Wasserstoff, Methyl, Methoxy, Ethoxy, Fluor, Chlor oder Brom ist;
R^4 Wasserstoff, Fluor oder Chlor ist;
R^5 Methyl, Ethyl, n-Propyl, i-Propyl oder C_{3-6}-Cycloalkyl ist;
Y $-CH_2-CH_2-$ oder $-CH=CH-$ ist und
Z



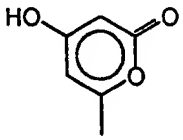
oder $-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ ist (worin R^{12} Wasserstoff, physiologisch hydrolysierbares Alkyl, NH_4, Natrium, Kalium oder 1/2 Calcium ist).

4. Verbindung nach Anspruch 1, worin R^1 Wasserstoff, Methyl, Ethyl, Methoxy, Ethoxy, Fluor oder Chlor ist;
R^2 Wasserstoff, Methoxy, Ethoxy, Fluor oder Chlor ist;
R^3 Wasserstoff, Methoxy, Ethoxy, Fluor oder Chlor ist;
R^4 Wasserstoff, Fluor oder Chlor ist;
R^5 Methyl, Ethyl, n-Propyl, i-Propyl oder C_{3-6}-Cycloalkyl ist;
Y $-CH=CH-$ ist und
Z



oder $-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ ist (worin R^{12} Wasserstoff, physiologisch hydrolysierbares Alkyl, NH_4, Natrium, Kalium oder 1/2 Calcium ist).

5. Verbindung nach Anspruch 1, worin R^1 Waserstoff, Methyl, Methoxy oder Chlor ist;
R^2 Wasserstoff oder Methoxy ist;
R^3 Wasserstoff, Fluor oder Chlor ist;
R^4 Wasserstoff ist;
R^5 i-Propyl oder Cyclopropyl ist;
Y $-CH=CH-$ ist und
Z



oder $-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ ist (worin R^{12} Wasserstoff, physiologisch hydrolysierbares Alkyl, NH_4, Natrium, Kalium oder 1/2 Calcium ist).

6. Verbindung nach Anspruch 1, die (E)-3,5-Dihydroxy-7-[4'-[4"-fluorphenyl)-2'-(1"-methylethyl)-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-fluorph nyl)-2'-(1"-methylethyl)-6'-chlor-chinolin-3'-yl]-hept-6- nsäur , in durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-fluorphenyl)-2'-(1"-methylethyl)-6'-methyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-fluorphenyl)-2'-(1"-methylethyl)-6',7'-dimethoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-fluorphenyl)-2'-cyclopropyl-chinolin-3'-yl]-hept-6-ensaure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-fluorphenyl)-2'-cyclopropyl-6'-chlor-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-fluorphenyl)-2'-cyclopropyl-6'-methyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-fluorphenyl)-2'-cyclopropyl-6',7'-dimethoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-chlorphenyl)-2'-(1"-methylethyl)-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-chlorphenyl)-2'-(1"-methylethyl)-6'-chlor-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-chlorphenyl)-2'-(1"-methylethyl)-6'methyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-chlorphenyl)-2'-(1"-methylethyl)-6',7'-dimethoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-chlorphenyl)-2'-cyclopropyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-chlorphenyl)-2'-cyclopropyl-6'-chlor-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-chlorphenyl)-2'-cyclopropyl-6'-methyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-chlorphenyl)-2'-cyclopropyl-6',7'-dimethoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'phenyl-2'-(1"-methylethyl)-6'-chlor-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-6'-methyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-6',7'-dimethoxy-chinolin-3'-yl]-hept-6-ensäure, ein

durch die Kondensation d r Carbonsäure mit Hydroxy an der 5-Position g bildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester d r Carbonsäur ,
(E)-3,5-Dihydroxy-7-[4'-phenyl-2'-cyclopropyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation d r Carbonsäur mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6'-chlor-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6'-methyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6',7'-dimethoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4''-fluorphenyl)-2'-(1''-methylethyl)-6'-methoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4''-fluorphenyl)-2'-cyclopropyl-6'-methoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure ist.

7. Der Hyperlipidämie entgegenwirkendes Mittel, enthaltend die Verbindung der Formel I, wie in Anspruch 1 definiert.

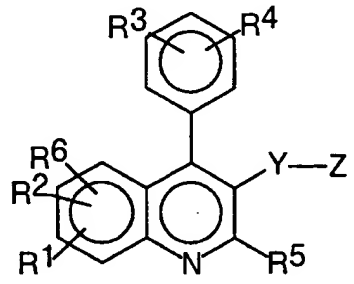
8. Der Hyperlipoproteinämie entgegenwirkendes Mittel, enthaltend die Verbindung der Formel I, wie in Anspruch 1 definiert.

9. Der Atherosklerose entgegenwirkendes Mittel, enthaltend die Verbindung der Formel I, wie in Anspruch 1 definiert.

10. Verwendung einer Verbindung nach Anspruch 1 zur Herstellung eines therapeutischen Mittels zur Verringerung der Hyperlipidämie, Hyperlipoproteinämie oder Artherosklerose.

Patentansprüche für folgende Vertragsstaaten : ES, GR

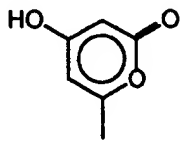
1. Verfahren zum Herstellen einer Verbindung der Formel:



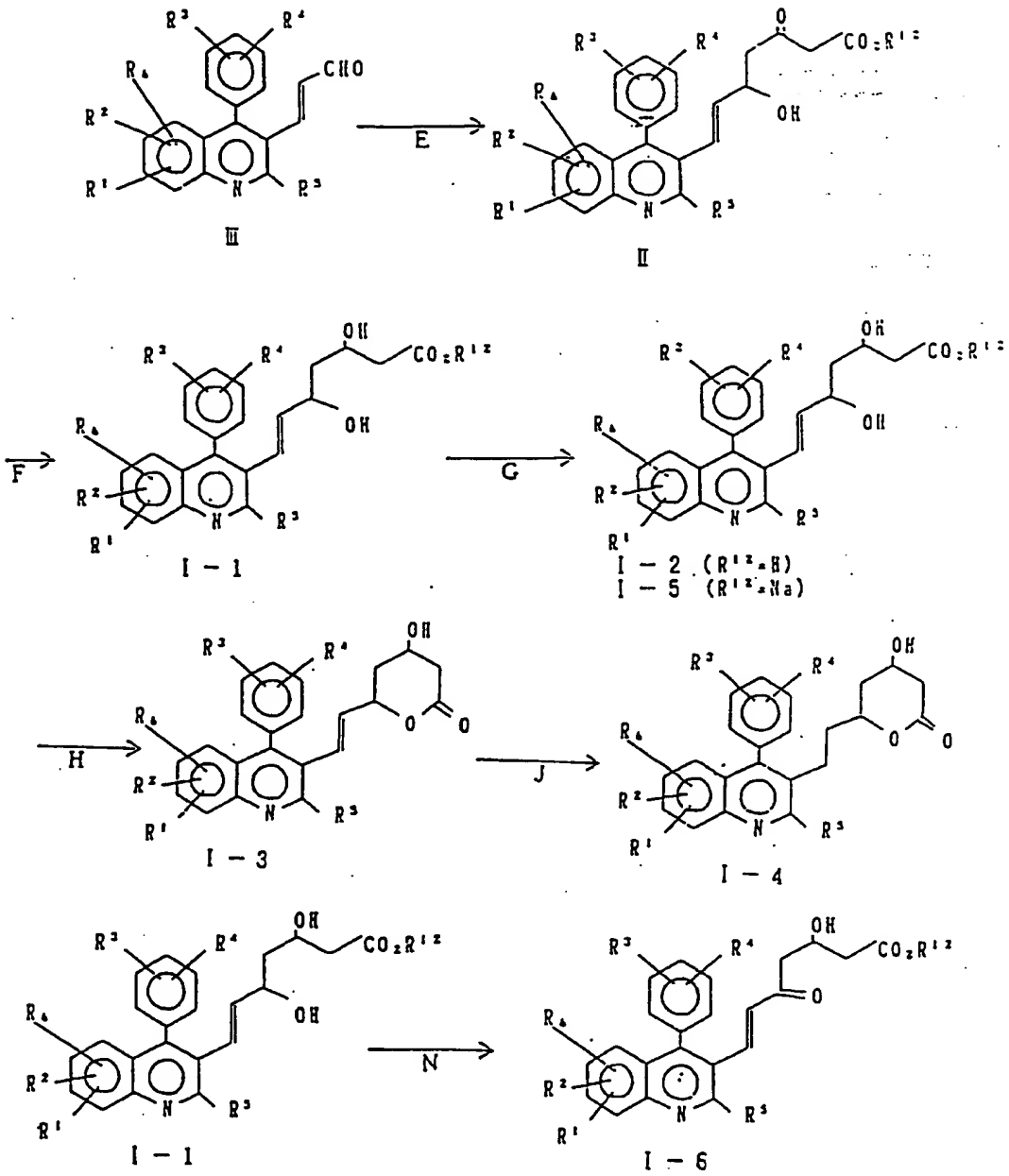
(I)

worin R^1 Wasserstoff, C_{1-4}-Alkyl, C_{1-3}-Alkoxy, n-Butoxy, i-Butoxy, sec-Butoxy, R^7R^8N- (worin R^7 und R^8 C_{1-3}-Alkyl sind), Fluor, Chlor, Brom oder Benzyloxy ist;
R^2 Wasserstoff, C_{1-4}-Alkyl, C_{1-3}-Alkoxy, n-Butoxy, i-Butoxy, sec-Butoxy, Fluor, Chlor oder Brom ist; oder
wenn sie in der o-Position zueinander angeordnet sind, R^1 und R^2 zusammen -CH=CH-CH=CH- bilden;
R^3 Wasserstoff, C_{1-4}-Alkyl, C_{1-3}-Alkoxy, n-Butoxy, i-Butoxy, sec-Butoxy, Fluor, Chlor, Brom, Trifluormethyl, Phenoxy, Phenyl oder Benzyloxy ist;

R^4 Wasserstoff, C_{1-4}-Alkyl, Fluor, Chlor od r Brom ist;
R^5 C_{1-6}-Alkyl, C_{1-3}-Cycloalkyl oder Phenyl ist;
R^6 Wasserstoff ist;
Y $-CH_2-$, $-CH_2CH_2-$, $-CH=CH-$, $-CH_2CH=CH-$ oder $-CH=CH-CH_2-$ ist und
Z



oder $-Q-CH_2-W-CH_2-CO_2R^{12}$ ist (worin Q -C(O)- oder -CH(OH)- ist; W -C(O)- oder -CH(OH)- ist und R^{12} Wasserstoff, physiologisch hydrolysierbares Alkyl, NH_4, Natrium, Kalium oder 1/2 Calcium ist), dadurch gekennzeichnet, daß die Verbindungen der Formel (I) nach dem folgenden Reaktionsschema hergestellt werden:



worin R^1, R^2, R^3, R^4, R^5, R^6 und R^{12} die oben mit Bezug auf Anspruch 1 definierte Bedeutung haben und R^{21} und R^{22} unabhängig für C_{1-4}-Alkyl stehen, worin

Stufe E eine Doppelanion-Kondensationsreaktion zwischen dem ungesättigten Aldehyd III und einem Acetoacetat unter Verwendung von Natriumhydrid und n-Butyllithium in Tetrahydrofuran bei einer Temperatur von -80 bis 0 °C repräsentiert;

Stufe F eine Reduktionsreaktion der Carbonylgruppe unter Einsatz von Metallhydrid in Ethanol bei einer Temperatur von -10 bis 25 °C oder unter Einsatz von Zinkborhydrid in trockenem Ethylether oder trockenem Tetrahydrofuran bei einer Temperatur von -100 bis 25 °C darstellt;

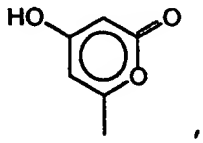
Stufe G eine Stufe zum Hydrolysieren des Esters unter Einsatz iner äquimolaren Menge einer Base in einer Lösungsmittelmischung aus Wasser und Methanol oder Ethanol bei einer Temperatur von 10 bis 25 °C ist;

Stufe H eine Stufe der Bildung eines Mevalonolactons durch Dehydratationsreaktion der freien Hydroxysäure I-2 ist;

Stufe J eine Reaktion d r Hydrierung der Doppelbindung, di die Mevalonolacton-Gruppierung und den Chinolinring verbindet, unter Einsatz einer katalytischen Menge von Palladium-Kohlenstoff oder Rhodium-Kohlenstoff in einem Lösungsmitt l bei einer Temperatur von 0 bis 50 °C repräsentiert und

Stufe N ine Umsetzung zur Synthes in s α,β-ung sättigten Ketons durch selektive Oxidation des Dihydroxycarbonsäureesters unter Einsatz von aktiviertem Mangandioxid in einem Lösungsmittel bei einer Temperatur von 20 bis 80 °C repräsentiert.

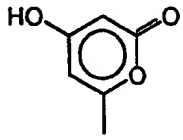
2. Verfahren nach Anspruch 1, worin in Formel I R^1 Wasserstoff, Fluor, Chlor, Brom, C_{1-4}-Alkyl oder C_{1-3}-Alkoxy ist;
R^2 Wasserstoff, C_{1-3}-Alkoxy, Fluor, Chlor oder Brom ist;
R^3 Wasserstoff, C_{1-4}-Alkyl, C_{1-3}-Alkoxy, Fluor, Chlor oder Brom ist;
R^4 Wasserstoff, Fluor, Chlor oder Brom ist;
R^5 C_{1-6}-Alkyl oder C_{1-3}-Cycloalkyl ist;
Y $-CH_2-CH_2-$ oder -CH=CH- ist und
Z



,

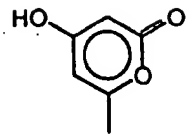
$-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ oder $-CH(OH)CH_2C(O)CH_2CO_2R^{12}$ ist (worin R^{12} Wasserstoff, physiologisch hydrolysierbares Alkyl, NH_4, Natrium, Kalium oder 1/2 Calcium ist).

3. Verfahren nach Anspruch 1, worin R^1 Wasserstoff, Methyl, Ethyl, n-Propyl, i-Propyl, Methoxy, Ethoxy, Fluor, Chlor oder Brom ist;
R^2 Wasserstoff, Methoxy, Ethoxy, Fluor, Chlor oder Brom ist;
R^3 Wasserstoff, Methyl, Methoxy, Ethoxy, Fluor, Chlor oder Brom ist;
R^4 Wasserstoff, Fluor oder Chlor ist;
R^5 Methyl, Ethyl, n-Propyl, i-Propyl oder C_{3-6}-Cycloalkyl ist;
Y $-CH_2-CH_2-$ oder -CH=CH- ist und
Z



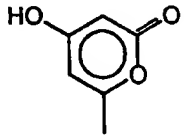
oder $-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ ist (worin R^{12} Wasserstoff, physiologisch hydrolysierbares Alkyl, NH_4, Natrium, Kalium oder 1/2 Calcium ist).

4. Verfahren nach Anspruch 1, worin R^1 Wasserstoff, Methyl, Ethyl, Methoxy, Ethoxy, Fluor oder Chlor ist;
R^2 Wasserstoff, Methoxy, Ethoxy, Fluor oder Chlor ist;
R^3 Wasserstoff, Methoxy, Ethoxy, Fluor oder Chlor ist;
R^4 Wasserstoff, Fluor oder Chlor ist;
R^5 Methyl, Ethyl, n-Propyl, i-Propyl oder C_{3-6}-Cycloalkyl ist;
Y -CH=CH- ist und
Z



oder -CH(OH)CH_2CH(OH)$CH_2CO_2R^{12}$ ist (worin R^{12} Wasserstoff, physiologisch hydrolysierbares Alkyl, NH_4, Natrium, Kalium oder 1/2 Calcium ist).

5. Verfahren nach Anspruch 1, worin R^1 Waserstoff, Methyl, Methoxy oder Chlor ist;
R^2 Waserstoff oder Methoxy ist;
R^3 Wasserstoff, Fluor oder Chlor ist;
R^4 Wasserstoff ist;
R^5 i-Propyl oder Cyclopropyl ist;
Y -CH = CH- ist und
Z



oder -CH(OH)CH_2CH(OH)$CH_2CO_2R^{12}$ ist (worin R^{12} Wasserstoff, physiologisch hydrolysierbares Alkyl, NH_4, Natrium, Kalium oder 1/2 Calcium ist).

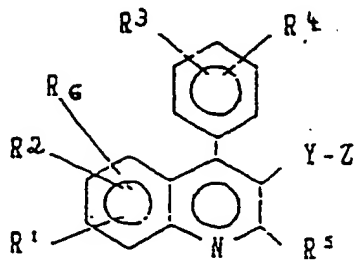
6. Verfahren nach Anspruch 1, das erzeugt (E)-3,5-Dihydroxy-7-[4'-[4''-fluorphenyl)-2'-(1''-methylethyl)-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4''-fluorphenyl)-2'-(1''-methylethyl)-6'-chlor-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4''-fluorphenyl)-2'-(1''-methylethyl)-6'-methyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4''-fluorphenyl)-2'-(1''-methylethyl)-6',7'-dimethoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4''-fluorphenyl)-2'-cyclopropyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4''-fluorphenyl)-2'-cyclopropyl-6'-chlor-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4''-fluorphenyl)-2'-cyclopropyl-6'-methyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4''-fluorphenyl)-2'-cyclopropyl-6',7'-dimethoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4''-chlorphenyl)-2'-(1''-methylethyl)-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder in Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4''-chlorphenyl)-2'-(1''-methylethyl)-6'-chlor-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,

(E)-3,5-Dihydroxy-7-[4'-(4"-chlorphenyl)-2'-(1"-methylethyl)-6'methyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-chlorphenyl)-2'-(1"-methylethyl)-6',7'-dimethoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-chlorphenyl)-2'-cyclopropyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-chlorphenyl)-2'-cyclopropyl-6'-chlor-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-chlorphenyl)-2'-cyclopropyl-6'-methyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-chlorphenyl)-2'-cyclopropyl-6',7'-dimethoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'phenyl-2'-(1"-methylethyl)-6'-chlor-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-6'-methyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-phenyl-2'-(1"-methylethyl)-6',7'-dimethoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-phenyl-2'-cyclopropyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6'-chlor-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6'-methyl-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-phenyl-2'-cyclopropyl-6',7'-dimethoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-fluorphenyl)-2'-(1"-methylethyl)-6'-methoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure,
(E)-3,5-Dihydroxy-7-[4'-(4"-fluorphenyl)-2'-cyclopropyl-6'-methoxy-chinolin-3'-yl]-hept-6-ensäure, ein durch die Kondensation der Carbonsäure mit Hydroxy an der 5-Position gebildetes Lacton oder ein Natriumsalz oder C_{1-3}-Alkylester der Carbonsäure.

Revendicati ns

Revendicati ns pour les Etats contractants suivants : CH, LI, AT, BE, DE, FR, GB, IT, NL, SE, LU

1. Composé de formule :



(I)

dans laquelle R^1 est hydrogène, alkyle en C_{1-4}, alcoxy en c_{1-3}, n-butoxy, iso-butoxy, sec-butoxy, R^7R^8N-(dans lequel R^7 et R^8 sont alkyle en C_{1-3}), fluoro, chloro, bromo ou benzyloxy;

R^2 est hydrogène, alkyle en C_{1-4}, alcoxy en C_{1-3}, n-butoxy, iso-butoxy, sec-butoxy, fluoro, chloro ou bromo;

ou encore R^1 et R^2 forment ensemble -CH=CH—CH=CH- lorsqu'ils sont situés en position ortho l'un par rapport à l'autre;

R^3 est hydrogène, alkyle en C_{1-4}, alcoxy en C_{1-3}, n-butoxy, iso-butoxy, sec-butoxy, fluoro, chloro, bromo, trifluorométhyle, phénoxy, phényle ou benzyloxy;

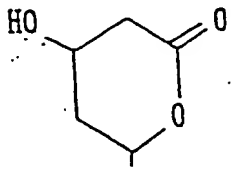
R^4 est hydrogène, alkyle en C_{1-4}, fluoro, chloro ou bromo;

R^5 est alkyle en C_{1-6}, cycloalkyle en C_{3-6} ou phényl;

R^6 est hydrogène;

Y est $-CH_2-$, $-CH_2CH_2-$, -CH=CH-, $-CH_2$-CH=CH- ou -CH=CH-CH_2 ; et

Z est



ou -Q-CH_2-W-CH_2-CO_2R^{12}

(dans lequel Q est -C(O)- ou -CH(OH)-; W est -C(O)- ou - CH(OH)-; et R^{12} est hydrogène, alkyle physiologiquement hydrolysable, NH_4, sodium, potassium ou 1/2 calcium).

2. Composé selon la revendication 1, dans la formule I duquel, R^1 est hydrogène, fluoro, chloro, bromo, alkyle en C_{1-4}, alcoxy en C_{1-3}

R^2 est hydrogène, alcoxy en C_{1-3}, fluoro, chloro ou bromo;

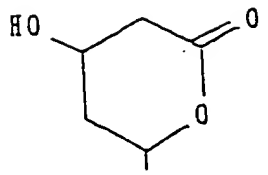
R^3 est hydrogène, alkyle en C_{1-4}, alcoxy en C_{1-3}, fluoro, chloro ou bromo ;

R^4 est hydrogène, fluoro, chloro ou bromo;

R^5 est alkyle en C_{1-6} ou cycloalkyle en C_{3-6};

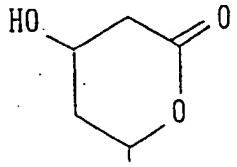
Y est $-CH_2-CH_2-$ ou -CH=CH-; et

Z est



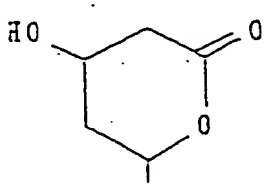
-CH(OH)CH_2CH(OH)$CH_2CO_2R^{12}$ ou -CH(OH)$CH_2C(O)CH_2CO_2R^{12}$ (dans lesquels R^{12} est hydrogène, alkyle physiologiquement hydrolysable, NH_4, sodium, potassium ou 1/2 calcium).

3. Composé selon la revendication 1, dans lequel R^1 est hydrogène, méthyle, éthyle, n-propyle, iso-propyle, méthoxy, éthoxy, fluoro, chloro ou bromo;
   R^2 est hydrogène, méthoxy, éthoxy, fluoro, chloro ou bromo;
   R^3 est hydrogène, méthyle, méthoxy, éthoxy, fluoro, chloro ou bromo;
   R^4 est hydrogène, fluoro ou chloro;
   R^5 est méthyle, éthyle, n-propyle, iso-propyle ou cycloalkyle en C_{3-6};
   Y est -CH_2CH_2- ou -CH=CH-; et
   Z est



ou -CH(OH)CH_2CH(OH)$CH_2CO_2R^{12}$ (dans lequel R^{12} est hydrogène, alkyle physiologiquement hydrolysable, NH_4, sodium, potassium ou 1/2 calcium).

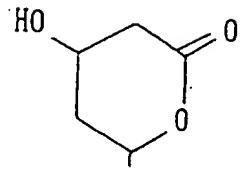
4. Composé selon la revendication 1, dans lequel R^1 est hydrogène, méthyle, éthyle, méthoxy, éthoxy, fluoro ou chloro;
   R^2 est hydrogène, méthoxy, éthoxy, fluoro ou chloro;
   R^3 est hydrogène, méthoxy, éthoxy, fluoro ou chloro ;
   R^4 est hydrogène, fluoro ou chloro;
   R^5 est méthyle, éthyle, n-propyle, iso-propyle ou cycloalkyle en C_{3-6};
   Y est -CH=CH-; et
   Z est



ou -CH(OH)CH_2CH(OH)$CH_2CO_2R^{12}$ (dans lequel R^{12} est hydrogène, alkyle physiologiquement hydrolysable, NH_4, sodium, potassium ou 1/2 calcium).

5. Composé selon la revendication 1, dans lequel R^1 est hydrogène, méthyle, méthoxy ou chloro;
   R^2 est hydrogène ou méthoxy;
   R^3 est hydrogène, fluoro ou chloro;
   R^4 est hydrogène;
   R^5 est iso-propyle ou cyclopropyle;
   Y est -CH=CH-; et

Z est



ou $-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ (dans lequel R^{12} est hydrogène, alkyle physiologiquement hydrolysable, NH_4, sodium, potassium ou 1/2 calcium).

6. Composé selon la revendication 1, qui est l'acide (E)-3,5-dihydroxy-7-[4'-(4"-fluorophényl)-2'-(1"-méthyléthyl)-quinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-fluorophényl)-2'-(1"-méthyléthyl)-6'-chloro-quinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-fluorophényl)-2'-(1"-méthyléthyl)-6'-méthylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-fluorophényl)-2'-(1"-méthyléthyl)-6',7'-diméthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-fluorophényl)-2'-cyclopropylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-fluorophényl)-2'-cyclopropyl-6'-chloroquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-fluorophényl)-2'-cyclopropyl-6'-méthylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-fluorophényl)-2'-cyclopropyl-6',7'-diméthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-(1"-méthyléthyl)-quinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-(1"-méthyléthyl)-6'-chloroquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-(1"-méthyléthyl)-6'-méthylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-(1"-méthyléthyl)-6',7'-diméthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-cyclopropylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-cyclopropyl-6'-chloroquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-cyclopropyl-6'-méthylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en

position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-cyclopropyl-6',7'-diméthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ster d'alkyl n C_{1-3} de l'acid carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-(1"-méthyléthyl)-quinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-(1"-méthyléthyl)-6'-chloroquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-(1"-méthyléthyl)-6'-méthylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-(1"-méthyléthyl)-6',7'-diméthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-cyclopropylquinoléin-3'-yl]-hept-6-énoique, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-cyclopropyl-6'-chloroquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-cyclopropyl-6'-méthylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-cyclopropyl-6',7'-diméthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-fluorophényl-2'-(1"-méthyléthyl)-6'-méthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;ou

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-fluorophényl)-2'-cyclopropyl-6'-méthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

7. Agent antihyperlipidémiant contenant un composé de formule I telle que définie dans la revendication 1.

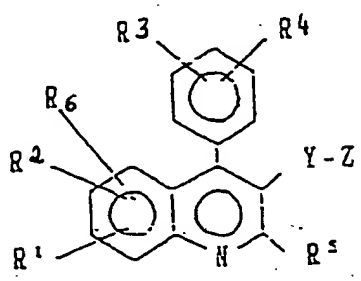
8. Agent antihyperlipoprotéinémiant contenant un composé de formule I telle que définie dans la revendication 1.

9. Agent pour lutter contre l'athérosclérose contenant un composé de formule I telle que définie dans la revendication 1.

10. Utilisation d'un composé selon la revendication 1 pour la fabrication d'un agent thérapeutique destiné à réduire l'hyperlipidémie, l'hyperlipoprotéinémie ou l'athérosclérose.

Revendications pour l s Etats contractants suivants : ES, GR

1. Procédé pour la préparation d'un composé de formule:



(I)

dans laquelle R^1 est hydrogène, alkyle en C_{1-4}, alcoxy en C_{1-3}, n-butoxy, iso-butoxy, sec-butoxy, R^7R^8N-(dans lequel R^7 et R^8 sont alkyle en C_{1-3}), fluoro, chloro, bromo ou benzyloxy;

R^2 est hydrogène, alkyle en C_{1-4}, alcoxy en C_{1-3}, n-butoxy, iso-butoxy, sec-butoxy, fluoro, chloro ou bromo;

ou encore R^1 et R^2 forment ensemble -CH=CH=CH=CH- lorsqu'ils sont situés en position ortho l'un par rapport à l'autre;

R^3 est hydrogène, alkyle en C_{1-4}, alcoxy en C_{1-3}, n-butoxy, iso-butoxy, sec-butoxy, fluoro, chloro, bromo, trifluorométhyle, phénoxy, phényle ou benzyloxy;

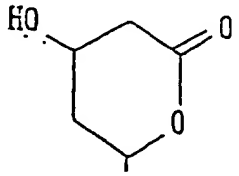
R^4 est hydrogène, alkyle en C_{1-4}, fluoro, chloro ou bromo;

R^5 est alkyle en C_{1-6}, cycloalkyle en C_{3-6} ou phényle,

R^6 est hydrogène;

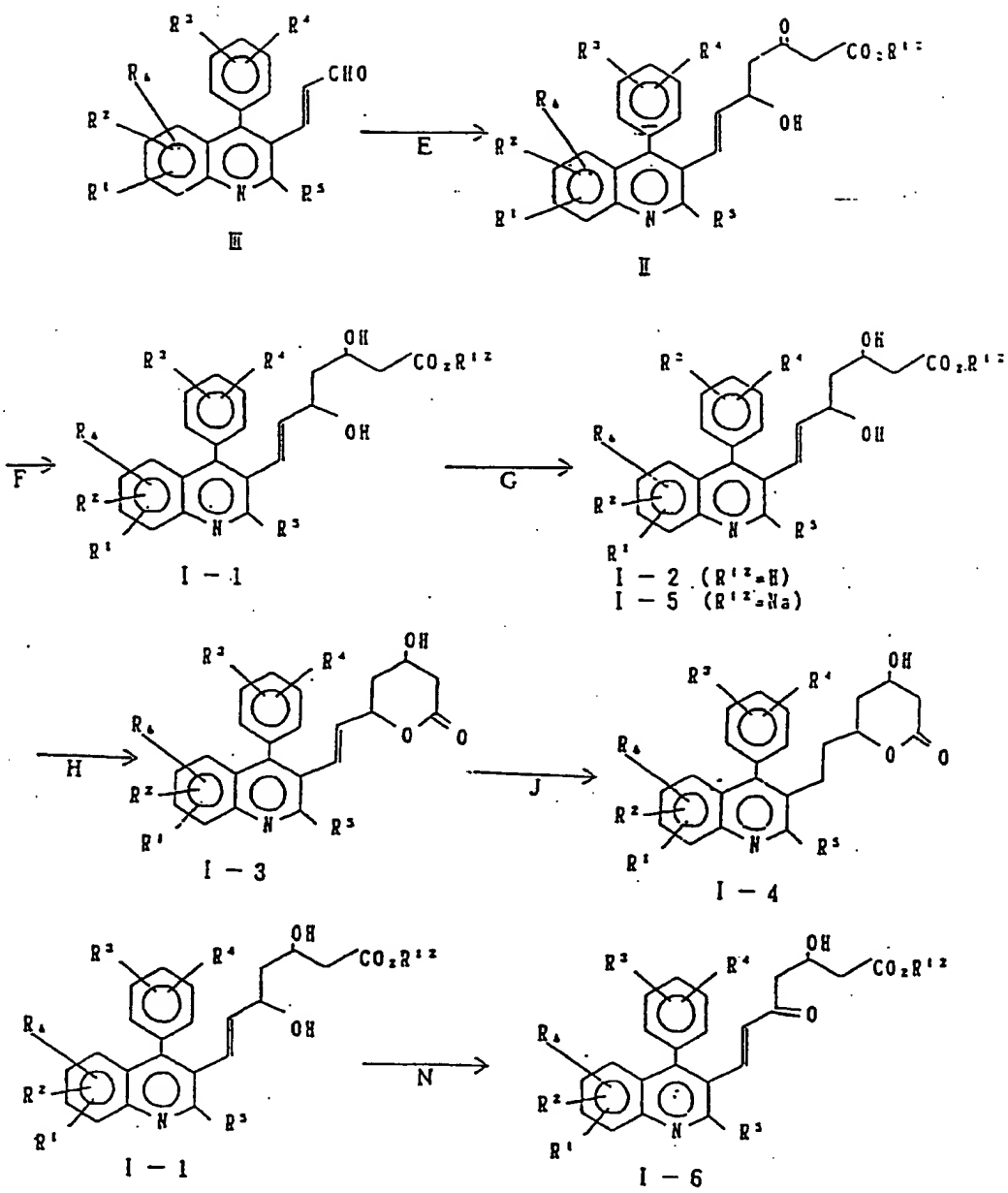
Y est $-CH_2-$, $-CH_2CH_2-$, -CH=CH-, $-CH_2-CH=CH-$ ou $-CH=CH-CH_2$; et

Z est



ou $-Q-CH_2-W-CH_2-CO_2R^{12}$

(dans lequel Q est -C(O)- ou -CH(OH)-; W est -C(O)- ou - CH(OH)-; et R^{12} est hydrogène, alkyle physiologiquement hydrolysable, NH_4, sodium, potassium ou 1/2 calcium), procédé caractérisé en ce que les composés de formule (I) sont préparés selon le schéma réactionnel suivant:



dans lequel R^1, R^2, R^3, R^4, R^5, R^6 et R^{12} sont tels que définis ci-dessus d'après la formule I, et R^{21} et R^{22} représentent indépendamment alkyle en C_{1-4}; dans lequel

l'étape E représente une réaction de condensation par double anion entre l'énal III et un acétoacétate en employant de l'hydrure de sodium et du n-butyllithium dans du tétrahydrofuranne à une température de -80 °C à 0 °C;

l'étape F représente une réaction de réduction du groupe carbonyle en employant un hydrure métallique dans de l'éthanol à une température de -10 °C à 25 °C ou en employant un borohydrure de zinc dans de l'éther diéthylique anhydre ou du tétrahydrofuranne anhydre à une température de -100 °C à 25 °C;

l'étape G est une étape d'hydrolyse de l'ester en employant une base en quantité équimolaire dans un mélange de solvants constitué d'eau et de méthanol ou d'éthanol à une température de 10 à 25 °C;

l'étape H est une étape de formation d'une mévalonolactone par une réaction de déshydratation de l'hydroxyacide libre I-2;

l'étape J représente une réaction d'hydrogénation de la double liaison entr le résidu mévalonolac-

tone et le cycle quinoléinique en employant du palladium-carbon ou du rhodium-carbon n quantité catalytique dans un solvant à une température de 0 à 50 • C; et

l'étape N représente une réaction de synthèse d'une cétone α,β-insaturée par l'oxydation sélective de l'ester d l'acid dihydroxycarboxyliqu à l'aide d dioxyd d manganèse activé dans un solvant à une température de 20 à 80 • C.

2. procédé selon la revendication 1, dans lequel dans la formule I, R^1 est hydrogène, fluoro, chloro, bromo, alkyle en C_{1-4} ou alcoxy en C_{1-3} ;

R^2 est hydrogène, alcoxy en C_{1-3}, fluoro, chloro ou bromo ;

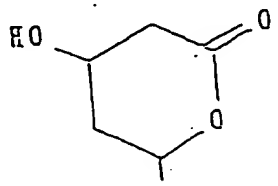
R^3 est hydrogène, alkyle en C_{1-4}, alcoxy en C_{1-3}, fluoro, chloro ou bromo ;

R^4 est hydrogène, un radical fluoro, chloro ou bromo;

R^5 est alkyle en C_{1-6} ou cycloalkyle en C_{3-6};

Y est $-CH_2-CH_2-$ ou $-CH=CH-$; et

Z est



$-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ ou $-CH(OH)CH_2C(O)CH_2CO_2R^{12}$ (dans lesquels R^{12} est hydrogène, alkyle physiologiquement hydrolysable, NH_4, sodium, potassium ou 1/2 calcium).

3. Procédé selon la revendication 1, dans lequel R^1 est hydrogène, méthyle, éthyle, n-propyle, iso-propyle, méthoxy, éthoxy, fluoro, chloro ou bromo;

R^2 est hydrogène, méthoxy, éthoxy, fluoro, chloro ou bromo;

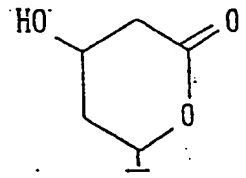
R^3 est hydrogène, méthyle, méthoxy, éthoxy, fluoro, chloro ou bromo;

R^4 est hydrogène, fluoro ou chloro;

R^5 est méthyle, éthyle, n-propyle, iso-propyle ou cycloalkyle en C_{3-6};

Y est $-CH_2CH_2-$ ou $-CH=CH-$; et

Z est



ou $-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ (dans lequel R^{12} est hydrogène, alkyle physiologiquement hydrolysable, NH_4, sodium, potassium ou 1/2 calcium).

4. Procédé selon la revendication 1, dans lequel R^1 est hydrogène, méthyle, éthyle, méthoxy, éthoxy, fluoro ou chloro;

R^2 est hydrogène, méthoxy, éthoxy, fluoro ou chloro;

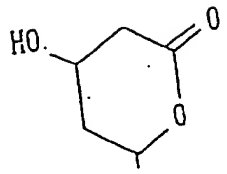
R^3 est hydrogène, méthoxy, éthoxy, fluoro ou chloro;

R^4 est hydrogène, fluoro ou chloro;

R^5 est méthyle, éthyle, n-propyle, iso-propyle ou cycloalkyle en C_{3-6};

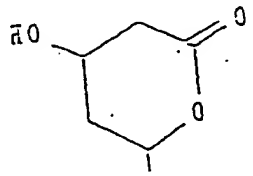
Y est $-CH=CH-$; et

Z est



ou $-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ (dans lequel R^{12} est hydrogène, alkyle physiologiquement hydrolysable, NH_4, sodium, potassium ou 1/2 calcium).

5. Procédé selon la revendication 1, dans lequel R^1 est hydrogène, méthyle, méthoxy ou chloro;
R^2 est hydrogène ou méthoxy;
R^3 est hydrogène, fluoro ou chloro;
R^4 est hydrogène;
R^5 est iso-propyle ou cyclopropyle;
Y est -CH = CH-; et
Z est



ou $-CH(OH)CH_2CH(OH)CH_2CO_2R^{12}$ (dans lequel R^{12} est hydrogène, alkyle physiologiquement hydrolysable, NH_4, sodium, potassium ou 1/2 calcium).

6. Procédé selon la revendication 1, qui produit l'acide (E)-3,5-dihydroxy-7-[4'-(4''-fluorophényl)-2'-(1''-méthyléthyl)-quinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;
l'acide (E)-3,5-dihydroxy-7-[4'-(4''-fluorophényl)-2'-(1''-méthyléthyl)-6'-chloro-quinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;
l'acide (E)-3,5-dihydroxy-7-[4'-(4''-fluorophényl)-2'-(1''-méthyléthyl)-6'-méthylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;
l'acide (E)-3,5-dihydroxy-7-[4'-(4''-fluorophényl)-2'-(1''-méthyléthyl)-6',7'-diméthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;
l'acide (E)-3,5-dihydroxy-7-[4'-(4''-fluorophényl)-2'-cyclopropylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;
l'acide (E)-3,5-dihydroxy-7-[4'-(4''-fluorophényl)-2'-cyclopropyl-6'-chloroquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5; ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;
l'acide (E)-3,5-dihydroxy-7-[4'-(4''-fluorophényl)-2'-cyclopropyl-6'-méthylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;
l'acide (E)-3,5-dihydroxy-7-[4'-(4''-fluorophényl)-2'-cyclopropyl-6',7'-diméthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;
l'acide(E)-3,5-dihydroxy-7-[4'-(4''-chlorophényl)-2'-(1''-méthyléthyl)-quinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou

un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxyliqu ;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-(1"-méthyléthyl)-6'-chloroquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un s l d sodium ou un ester d'alkyle en C_{1-3} de l'acid carboxyliqu ;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-(1"-méthyléthyl)-6'-méthylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-(1"-méthyléthyl)-6',7'-diméthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-cyclopropylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-cyclopropyl-6'-chloroquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-cyclopropyl-6'-méthylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-chlorophényl)-2'-cyclopropyl-6',7'-diméthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-(1"-méthyléthyl)-quinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-(1"-méthyléthyl)-6'-chloroquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-(1"-méthyléthyl)-6'-méthylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-(1"-méthyléthyl)-6',7'-diméthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-cyclopropylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-cyclopropyl-6'-chloroquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-cyclopropyl-6'-méthylquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-phényl-2'-cyclopropyl-6',7'-diméthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-fluorophényl-2'-(1"-méthyléthyl)-6'-méthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique;

l'acide (E)-3,5-dihydroxy-7-[4'-(4"-fluorophényl)-2'-cyclopropyl-6'-méthoxyquinoléin-3'-yl]-hept-6-énoïque, une lactone produite par condensation de l'acide carboxylique avec le groupe hydroxy en position 5, ou un sel de sodium ou un ester d'alkyle en C_{1-3} de l'acide carboxylique.